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COSTS OF ESTABLISHING AND OPERATING FIELD NURSERIES DIFFERENTIATED BY SIZE OF FIRM AND SPECIES OF PLANT IN U.S.D.A. PLANT HARDINESS ZONES FIVE AND SIX

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PREFACE

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ABSTRACT

The objective of this study was to develop the resources and costs associated with two model field nurseries differentiated by size, including the delineation of representative production systems for field-grown nursery products. Calculations were based on 1985 prices. One plant species from each of the five delineated systems was chosen as representative of the group for specific production analysis. Total production costs per salable "B & B" plant by species in the 50 acre nursery were $17.47 for slow growing evergreens (Taxus), $12.52 for rapid growing evergreens (Juniperus), $12.00 for deciduous shrubs (Viburnum), $54.58 for shade trees (Acer rubrum), and $37.22 for ornamental trees (Malus) and averaged $20.40 for all species. For the 200 acre nursery, comparable figures were $9.39 for slow growing evergreens (Taxus), $7.07 for rapid growing evergreens (Juniperus), $7.06 for deciduous shrubs (Viburnum), $35.61 for shade trees (Acer rubrum), $24.73 for ornamental trees (Malus) and averaged $12.43 for all groups. Fixed costs for all plant groups accounted for a greater proportion of total costs in the 50 acre nursery than in the 200 acre nursery, averaging 55% in the small nursery and 39% in the large. This is attributed to more efficient use of buildings, machinery and equipment in the large nursery. Cost differences among species were caused primarily by space requirements, length of the production cycle, cost of liners, and harvest labor requirements.
KEY WORDS: Field Nursery Production, production systems, size of nursery, nursery crop budgets, plant groups, costs

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by Reed D. Taylor, Harold H. Kneen, Elton M. Smith, David E. Hahn, Stanley Uchida

INTRODUCTION

To make more informed decisions as to whether to enter, leave, or expand field production, nurserymen require production, marketing and financial information. In this paper, cost models for production of crops representing five categories of field-grown production schemes and two sizes of nurseries in USDA Plant Hardiness Zones Five and Six (Fig. 1) are developed. Physical coefficients are included so the information can be readily updated and so individual nurserymen can use the models as standards against which to compare their own operations or planned operations. Information derived should provide a basis for decision-making for those evaluating the profitability of establishing a new field nursery, expanding an existing field nursery or shifting from field production to container production.

Nurserymen throughout the United States have been gradually shifting from field to container production for many species of plants (12). Large companies and many individual nurserymen who traditionally have produced field-grown stock have diversified operations by shifting part of their production to container-

grown plants. Containers allow greater flexibility in production and marketing and at least in some cases are less expensive than field production (12). On the other hand, risk is reduced when plans are grown in the field. Field grown plants have greater buffering against variations in moisture, nutrients, and temperature. Field grown plants will often survive with little damage conditions that would either kill or severely damage container grown plants unless they are overwintered. It is also easier to "hold-over" field grown plants when market conditions are not favorable. Field production continues to produce the majority of plants grown for the landscape. Changes and competition in the industry make it imperative that nurserymen systematically determine production costs.

Cost models have recently been developed for several species of plants in the Southern and North Central regions of the U.S. (2,3,4,5,6,7,9,10,11,12,13,14) Most of these models, while providing excellent information for individual species, did not attempt to develop comprehensive models for complete nursery operations. Taylor, et al., developed a comprehensive model applicable to Plant Hardiness Zone 6 for container-grown crops representing five categories of container-grown production schemes and two sizes of nurseries (14). Badenhop and Phillips (2) developed a similiar study for field-grown crops in USDA Plant Hardiness Zones 7 and 8 representing five categories of field-grown production schemes and two sizes of nurseries. Procedures and data developed by the two earlier comprehensive

studies have proven useful and complementary to this study.

OBJECTIVES

The general objective of this study was to develop the resources and costs associated with two model nurseries differentiated by size, including the delineation of representative field production systems. Specific objectives were to:

1. Model a series of production systems that would accomodate a majority of the plant species being field-grown in USDA Plant Hardiness Zones 5 and 6.
2. Analyze the important species of plants commonly grown in the field in USDA Plant Hardiness Zones 5 and 6, and assign each of them to one of the designated groups based on similarities of growing and production requirements.
3. Choose one species from each group as representative of the group for detailed cost analysis.
4. Design physical facilities including land areas, land improvements, irrigation systems, buildings, machine and equipment components, for two sizes of commercial field nurseries based on the model production systems.

MATERIALS AND METHODS

In the study, two model firms were synthesized using the conceptual framework of economic engineering wherein the "best proven practice" was included in each model. They were

synthesized based on the North Central region. If specific items were required (i.e. depth of the well), coefficients were based on the Columbus, Ohio area. The complete model included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation system; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with land preparation and ending with loading the finished product for wholesale distribution; and budgets for fixed and variable costs (12).

Data for this study were obtained from wholesale nurseries and nursery suppliers in the North Central region during the late Autumn and Winter of 1984 and the Spring of 1985. Price quotations obtained were for the 1985 production season. The basic goals in synthesizing the production facilities (see Figures 2 thru 5) were to minimize labor expenses, flow and movement of plant material and equipment, maximize the number of salable plants and allow future expansion.

The model small nursery consisted of 50 acres of which 40 acres was growing space and 10 acres production facilities, holding area, field bed area and roads. The large nursery was 200 acres in size with 170 acres being growing space and 30 acres production facilities, holding area, field bed area and roads. Initial analysis for the small nursery showed that equipment needed for a modern nursery could support a much larger operation. It was ascertained that it would take a nursery of at

least 200 acres to use modern facilities and equipment in an economically efficient manner.

Physical Plant and Equipment

Assumptions

Assumptions about the physical facilities and equipment can greatly affect its cost and thereby cost per salable plant. The authors included all items a nursery would typically require, thus the physical plant is probably more elaborate than many nurserymen would require. A nurseryman can easily eliminate or reduce items as required. However, it would require substantial effort to do the analysis on his own if they were not included. Some specific assumptions that add substantially to a "stripped down" facility are as follows:

Scale of Nursery Operation. It was assumed that each model nursery would be self sufficient except for tree "lining-out" stock. Many field nurseries would also have container grown plants with buildings, machinery and equipment being shared between operations. Shared facilities would significantly reduce costs associated with field operations. Field nurseries, especially small units (i.e. the 50 acre operation) may have the opportunity of renting both land and equipment, thus reducing capital investment.

Site. Land modification costs could be reduced if the nursery were located on gravelly or sandy soil with good natural drainage. Locating near an opern water source could reduce or eliminate the need for a well.

Expansion. Expansion was provided for, especially for the 50 acre nursery. It became obvious very quickly in the analysis that buildings, machinery and equipment needed for an efficient operation in the 50 acre nursery were adequate for a much larger system. A significant stumbling block to expansion, if just an adequate system were provided, would be in the irrigation components. For this reason, a larger irrigation pump, larger well casing diameter, larger in-ground water mains, and a more powerful traveler irrigation gun was provided than might have been necessary for the 50 acre nursery if expansion were not contemplated. The 50 acre nursery, as engineered, could be expanded to at least 200 acres with very little effort. While expansion was also provided for the larger nursery, it was much less than for the small. It was felt that if the 200 acre nursery were to get much larger it would start running into other "limiting factors" much faster than in the case of the 50 acre nursery. Different expandability factors for the two sized nurseries builds some bias into the analysis favoring the 200 acre nursery when comparing costs per salable plant between the two sized nurseries.

Machinery and Equipment. Purchase of new machinery and equipment was assumed for the model nurseries to achieve true replacement costs. Many nurserymen may choose to buy used equipment, rent equipment or time-share some expensive items with other nurseries.

General

A model facility was synthesized for both a 50 and 200 acre nursery (Figures 2 through 5). Both models were designed for future expansion. For example, the 50 acre nursery has a centrally located shipping and "order building" area for four semitractor loads of plant material surrounded by growing area (figures 2 and 3). Thus, expansion can occur with a minimum of disruption. If growing space were greatly expanded (to 200 acres), the central area could be easily expanded without affecting "permanent" facilities. Specific components for both sizes of nurseries are itemized in Tables 1 and 1a.

The same buildings and to a lesser degree machinery and equipment needed for the 50 acre nursery are also satisfactory for the 200 acre one. Most of the machinery and equipment, even in the large nursery, is under-used but must be available when needed.

Components

Land Improvement. For full utilization of the production facilities, holding area, and field-bed area, extensive grading, graveling, surface and underground drainage tiles were provided (Table 2). This area was graded to allow a gradual slope from a high point at the shipping area to lower points on the edges. In addition, every two rows of polyhouses were sloped toward each other to utilize a common buried 30-inch water tile that attaches to the grassy waterways at the perimeter of the central area. Liner bed areas and general field production were tiled with 4"

plastic tile, 30' on center, 42" deep using a herringbone design.

Due to irrigation needs and rainfall, the problem of ground erosion occurs. Even with low application rates, the need to allow for base soil saturation and the possibility of heavy natural rainfall necesitates graveling storage and shipping areas. For any area that heavy equipment may run over (roadways, shipping area and machine storage shed), #4 gravel was used. In other graveled areas, a finer #8 grade was utilized. Although the cost of this graveling operation is high, it is offset by greater efficiencies and dependability in the handling of plants, ability to reenter the areas after natural or artificial irrigation and reduction of soil erosion.

A pond was included even though it was assumed a well could be dug with sufficient regenerative water capacity. This was done to reduce the risk to plants while in holding areas in case of disruptions caused by repairs or electrical failure. An auxiliary take-off drive from the pump could be powered by a 75 HP tractor for temporary irrigation. The pond also functions as a discharge site when operating the pump at higher efficiency levels than needed for immediate irrigation purposes.

Buildings. Each nursery was assumed to require similar sized permanent buildings for the receiving of nursery stock/storage (50' x 40'), machinery repair/storage (50' x 40'), office space (20' x 20'), and restroom facilities (20' x 20').

Propagation facilities. For propagating the three classes of shrubs, the 50 acre nursery was provided with one-half of a

20' x 200' polyhouse and the 200 acre nursery a full 20' x 200' polyhouse. These propagation areas are equiped with double polyethylene covers and heating equipment.

Overwintering facilities. Polyhouses were provided to overwinter 1/4 of a year's shrub harvest. Four and one-half (20' x 200') polyhouses are provided for the 50 acre nursery and 20 are provided for the 200 acre nursery. These structures are larger than the traditional 14' x 96', but allow easier access and use of machinery, especially for "balled and burlapped" material. Cost per sq ft is essentially the same as for smaller structures.

Irrigation system. Irrigation systems were designed to minimize labor efforts and plant loss risk, yet provide sufficient irrigation capabilities to meet present and future water needs even under the most unlikely situations. A basic irrigation system is composed of four parts: water source, pumping equipment, inground irrigation pipe, and above ground irrigation pipe and materials (Tables 4, 4a, 4b, and 4c).

The water source must have adequate reserves to meet maximum water needs and sufficient purity to meet cultural requirements. Because municipal water is expensive, especially if the production site is located far from a center of population; a well in conjunction with a constructed lake or a site situated near an open water source would be desirable. The open water source would have to be chosen with care. Most open water sources have problems due to collection of water from many

sources. Shallow water sources have algae problems requiring special filters. Also, present/future demands made by industries downstream on upstream may adversely affect flow rates and chemical composition of the water. Construction requirements for a pond or lake would include sufficient holding capacity to meet potential water demands and an adequate water supply furnished either by water shed areas, tappable underground water, springs, or some other source. Our models assumed an adequate water source found approximately 60 feet below ground. The well was dug to a depth of 80 feet to ensure adequate recharging capacity. In some areas of USDA Plant Hardiness Zones 5 and 6, wells would have to be drilled to much greater depths which would result in higher costs.

To properly develop a comprehensive irrigation system, the following must be considered: water pressure requirements of the sprinkler heads and the traveler gun, water pressure loss due to pipe and valve friction, area to be irrigated at one time and potential future expansion.

Selection of a well pump is crucial to the nursery operation. As a basic guideline, the maximum pressure loss from entrance point to the farthest point of irrigation within a lateral should be under 20 percent of the pounds per square inch (psi) reading as found at the pump. This assures a constant rate of application from all sprinkler heads on the line. The second guideline is that the combined amount of water exiting the sprinklers and/or traveler gun used at one irrigation setting

must be less than the total flow of water coming from the pump. A 100 HP electric pump was selected to drive the water from an 80 foot deep well (Table 4c). It takes a 100 HP pump to supply enough pressure to drive the traveler gun discharging 450-500 gallons per minute. The well depth depends not only on the depth at which water is found at but also on the amount of water being drawn per minute by the pump. An electric motor was chosen because of realibility of performance, low maintenance cost and close availability of three-phase electrical power. In addition, the following were provided for protection: a simple housing unit to enclose the pump, a branch in the foot valve attachment for pumping from the adjacent above ground auxiliary water source, and a right angled gear drive added to the pump in case of a power outage. Using the provided equipment, a tractor can power the pump to provide water into the pond and in a separate operation move water from the pond through the irrigation system.

The third part of the irrigation system is the in-ground irrigation pipe. The advantages of inground water mains are: labor costs for pipe movement is eliminated, breakage due to equipment running over above ground pipe is eliminated, and lower initial cost of P.V.C. pipe compared to portable above ground aluminum. The inground system would be installed below the frost line (between 4 and 5 feet deep). As seen from diagrams 2 through 5, 8" P.V.C. pipe forms major laterals.

The fourth part of the irrigation system would be above ground and would include frost free hydrants. Three inch,

portable, latchless, aluminum portable pipe was provided for irrigation within the central area. Rotating #30BH rainbird sprinklers were provided for dispersing water in the central area. A traveler gun with a dispersion rate of 450-500 gallons per minute was provided for irrigating the growing-out areas.

Soil Conservation. Minimal soil conservation is provided. After the last plants are harvested in a field, the field is left fallow until the following Spring. Fallow fields are disked for weed control four times during summer months and then plowed in the fall in preparation for spring planting. A more intense conservation program might consist of summer green manure crops plowed under such as alfalfa or sudax; rye grasses/fescue grown inbetween rows of trees; and grass grown in waterways and on the surface of access roads. Leaving the fields planted in a cover crop for two years might be desirable in some cases. Nurserymen interested in a soil conservation program should contact agents of the Soil Conservation Service located nearest to their nursery for assistance in designing a sound conservation plan which would include good cultural practices. The costs of implementing a program would have to be identified and included as a part of the annual costs of operating the nursery. These costs would have to be captured in the costs of producing a salable plant.

ENTERPRISE MIX

We assumed that the two model nurseries would produce a diverse line of nursery stock. The length of the production

cycle for the different species grown will vary. Commonly grown nursery stock were divided into five cultural groups. While not all inclusive, the groups do permit a range of per unit costs to be developed as they relate in input costs and cultural factors. For analytical purposes, we assumed that each cultural group would occupy 20% of the growing area (i.e. 50 acre nursery = 8 acres per group; 200 acre nursery = 34 acres per group). Annual sales capacity for the 50 acre nursery would be 20,759 plants and for the 200 acre nursery 90,867 plants. For detailed analysis, one specific plant from each group was chosen as representative of the group. While it is recognized that other plants from each category would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the representative plant. The five groups with some of their cultural characteristics are listed below:

Group	Plant	Cultural Characteristics
I.	SLOW GROWING EVERGREENS	
	Taxus (species)	18-24" salable plant
	Buxus (species)	12" B&B
		10.2 sq. ft. per plant
II.	RAPID GROWING EVERGREENS	
	Juniperus	18-24" salable plant
	chinensis (varieties)	12" B&B
	horizontalis (varieties)	10.2 sq. ft. per plant
	Pinus strobus	
	Thuja (species)	

III.	DECIDUOUS SHRUBS	
	Viburnum (species)	18-24" salable plant
	Forsythia (species)	12" B&B
	Weigela (species)	11.9 sq. ft. per plant
	Ligustrum (species)	
IV.	SHADE TREES	
	Acer rubrum (varieties)	2" caliper
	Acer platanoides	24" B&B
	(varieties)	33.6 sq. ft. per plant
	Quercus (species)	
	Fraxinus (species)	
	Tilia (species)	
	Gleditsia (species)	
V.	ORNAMENTAL TREES	
	Malus (flowering crab)	5-6' (1 1/2 - 1 3/4"
	(species)	caliper)
	Prunus (Ornamental plums)	20" B&B
	(species)	28.7 sq. ft. per plant

Production Cost Budgets

Costs were established for all factors of production including management and invested capital. In economic terms, costs associated with factors of production inputted by owner/operators are often referred to as 'opportunity costs' or the income these factors could have received if they were employed elsewhere. For example, owners could usually be employed as managers at other nurseries, and money invested in

land, buildings, irrigation systems, and equipment could have earned interest if it had been placed in financial institutions.

Capital requirements for establishing the nurseries were first determined (Tables 1, 1a). Second, the physical factors associated with the 50 and 200 acre nurseries and annual shipment requirements were established (Tables 6, 6a, 6b, 6c, and 7). Third, production systems for the enterprises budgeted were described (Appendices A thru F). Fourth, annual fixed costs were calculated (Tables 5 and 5a). Fifth, estimated variable costs for each of the five groupings of plants for the 50 and 200 acre nurseries were determined (Tables 8 thru 12a). Sixth, summaries were made of fixed and variable costs for each plant group size of nursery (Tables 14 and 15). This allowed cost comparisons based on cultural group and size of nursery.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis. Analyses on a "cash" basis do not give a true economic picture of the cost of producing a plant as it does not take into account the time value of money from the time the plant is planted until it is harvested. The analyses do, however, give a true estimate of the annual cost per salable plant. Another problem with cash accounting is taking into account the start-up period (i.e. the period from when costs are first incurred until salable plants are ready). This paper did not attempt to access costs or alternative actions for this period.

Fixed Costs

Annual fixed costs are presented in tables 5 and 5a. Most of these derived costs were based on the physical plant and equipment discussed previously. These costs were grouped into five categories: land and land improvements, buildings machinery and equipment, general overhead, and opportunity cost of capital for general overhead, insurance and taxes. Annual fixed costs for land and land improvements, buildings and machinery and equipment were composed of depreciation, interest, insurance, and taxes. Depreciation was calculated by dividing initial cost adjusted for salvage value by the years of useful life. Interest costs were estimated by multiplying the initial value of land and land improvements, buildings, machinery, and equipment by 12% per annum. Taxes and insurance costs were based on rates prevailing in the rural areas adjacent to Columbus, Ohio. Land, land improvements, and buildings were assessed taxes at the rate of $20 per $1,000 of market value. Insurance was set at $4.46 per $1,000 of market value for buildings and $3.78 per $1,000 of initial value for equipment. Costs for general overhead were determined on a current basis. Interest charges for general overhead, insurance, and taxes were computer for a 6-month average use period at a rate of 12% per annum.

General Overhead. Cost items not described in detail elsewhere, but which make up a substantial portion of annual fixed costs are placed here. These costs can be classified as follows: utilities, licenses and bonds, advertising and printing, insurance-personnel, travel and other, professional fees,

administrative and management, and miscellaneous. Utilities include heat, electricity and telephone services to the production department. It does not include fuel for equipment or machinery. Licenses and bonds are made up of expenses for inspection and certification to sell plants. General maintenance and repairs includes those expenses of maintaining roads and minor repairs to buildings which cannot be capitalized plus maintenance of grounds such as grass cutting and litter pickup. Advertising and printing involve procurement of letterhead items, nursery signs, employee handbooks and want ads for employment. Insurance for personnel includes workmen's compensation, FICA, health insurance, plus unemployment insurance for administration and management personnel (hourly laborers costs are included in hourly rates). Travel and other are made up of expenses to extension workshops, state meetings and regional meetings. Professional fees include membership costs of national, state, and local nursery associations. Administration and management are made up of salaries or wages of clerical personnel, management and supervisory personnel, miscellaneous insurance, and office supplies. Miscellaneous includes replacement of office equipment not depreciable plus unexpected costs. It should be noted that this item could be significantly reduced if many of the costs, especially administrative and management, were shared with a container operation or some other type of business.

To determine annual fixed costs per cultural group, total annual fixed costs were simply divided by five. Annual fixed

costs per salable plant were then determined by dividing the annual number of salable plants in each group into the annual fixed costs allocated to that group.

Variable Costs

Variable costs include all cost factors that vary with the quantity of plants being grown at one point in time. For example, the number of liners required for spring planting depends upon the quantity of plants management desires to have in inventory plus production losses. The loss factor for propagation, in the case of the shrubs (plant categories I, II, and III), was estimated at 23% (1.3 stuck cuttings to produce a healthy rooted cutting for). The loss factor for shrubs, in the bedding area, was estimated at 20% (1.25 rooted cuttings would need to be planted in the bedding area for each healthy plant available for transplanting into the field). Field losses from the time of planting until shipping were estimated at 15% for the shrubs (plant categories I, II, and III), and at 10% for the trees (plant categories IV and V).

Variable costs were subdivided into the following categories: propagation for the shrub groups, materials, machinery and equipment, labor, and interest on operating capital. These costs were determined for each group of plants using a specific plant as the representative for the group (Tables 8 thru 12a).

Propagation. Propagation costs were made up of rooting media (sand), labor for collecting, stripping, sticking,

maintainance, harvesting, and for hormone powder.

Liners. For the shrubs (plant categories I, II, III) liners were produced at the nursery. For the trees (plant categories IV, and V) they were purchased. Two costs compose the total for purchased liners. The major cost is the purchase price. While price is somewhat dependent upon quality and quantity, it was assumed that sufficient quality units would be ordered in either sized nursery to obtain them at the lowest possible cost. The second cost was for packing and shipping the liner from producer to purchaser. This was estimated at 10% of the purchase price. In each group of plants.

Burlap and twine. Burlap and twine was provided for "ball and burlapping" each plant produced. In addition, for Groups IV and V, wire baskets were purchased. The cost of the burlap,twine, and wire baskets reflects a delivered cost to the nursery.

Polyethylene film. The cost of the white translucent film delivered to the nursery.

Strip tags. Strip tags are provided for identifying plants by botanical name, common name, state plant was grown in, and nursery producer. Costs included printing and shipping charges.

Chemicals. Chemical costs were subdivided into three cultural programs. The first is the fertilizer. For field operations the price included custom spreading for a custom blend and lime. Price for urea included delivery to the nursery. The second is the herbicide, whose cost is the purchase price of the various pre-emergence and post-emergence materials. The third

combines insecticides and fungicides. Purchase price reflects total cost for the chemicals as local distributors were assumed. A special category of "other" was included under chemicals. Adequate chemicals were budgeted for normal control of insects and fungi. The "other" category budgeted at 50% of the cost of the "normal" insecticides and fungicides was to take care of special problems.

Poultry wire. Poultry wire was provided for the two tree categories to protect tree trunks from rabbit damage.

Machinery and equipment. Variable machinery and equipment costs represent all costs incurred while equipment or machinery is in use. These costs are comprised of repair, fuel and lubrication/filter (Table 13). Repair cost per hour was calculated by multiplying initial cost by a stated repair percentage divided by the estimated lifetime use of the machinery in the large nursery in hours. The same repair cost per hour was used for both sized nurseries. Fuel costs were determined by multiplying units of fuel used per hour by the price per unit. Filter/lubrication cost was estimated at a constant factor of 15% of calculated fuel cost. Summation of repair, fuel and filter/lubrication costs result in total variable cost per hour of machinery or equipment useage. These costs were divided equally between the five plant groups.

Hourly labor. The hourly basic wage was estimated at $5.25. An additional 32% or $1.68 was allocated for various fringe benefits making a total hourly labor cost of $6.93. Each major

production activity was allocated necessary labor hours to accomplish assigned tasks.

Cost Summaries

After all cost factors were determined, they were summarized based upon cost per saleable plant by group and size of nursery.

RESULTS AND DISCUSSION

Capital Investment Requirements

Capital investment requirements for establishing field nurseries were itemized under three broad divisions: land and improvements, buildings, and machinery and equipment (Tables 1, 1a). Each was further divided into several components. The 50 acre nursery required $616,208 in investment. Land and land improvements represented 35% or $215,156 of the investment, buildings 20% or $121,805, and machinery and equipment 45% or $279,247. The 200 acre nursery had an initial investment requirement of $1,379,236. Land and land improvements represented 50% or $684,210 of the investment, buildings 12% or $165,981, and machinery and equipment 38% or $529,045. The difference in the percent of total investment between the various components of the two nurseries was primarily caused by the larger nursery being able to make more efficient use of buildings, machinery, and equipment than the smaller nursery. Both nurseries were about equally efficient in the use of growing space.

Land improvement costs, including the pond, in the case of

the 50 acre nursery was about 115% of the cost of bare land, but dropped to about 70% of the cost of bare land in the case of the 200 acre nursery. These land improvement costs would be necessary in 'normal' USDA Plant Hardiness Zones 5 and 6 to provide drainage, water storage, and good access to fields in times of inclement weather.

Building needs included a simple office layout, a plant and supply storage building, a machine shop for repairs and storage, polyhouse space for propagation, and polyhouses for overwintering. Details on polyhouse construction are included in Table 3 and those for the irrigation system including the pump and well are found in Tables 4, 4a, 4b, and 4c.

An important consideration for managers in most industries is determination of investment per unit of production capacity. For field nurseries this indicator would be the capital requirement per-salable-plant capacity. To determine this figure it was necessary to determine how many salable plants would be produced annually for each group in its allocated 20% of the growing space. This quantity ranged from a low of 1,869 for Group IV (Acer rubrum) to 6,208 for Group III (Viburnum) in the 50 acre nursery and from 8,177 to 27,162 in the 200 acre nursery for the same two groups respectively. The number of plants grown per unit of space directly relates to the capital requirements per-salable-plant. These capital costs for the small nursery differentiated by plant group were: $29.77 for Group I (Taxus), $21.21 for Group II (Juniperus), $19.85 for Group III (Viburnum),

$65.94 for Group IV (Acer rubrum), and $45.11 for Group V (Malus). The average for all groups was $29.68. For the 200 acre nursery the respective figures were: $15.19 for Group I, $10.85 for Group II. $10.16 for Group III, $33.73 for Group IV, and $23.07 for group V. The average for all groups was $15.18. It was almost one-half as expensive to provide salable plant capacity in the 200 acre nursery than in the 50 acre.

Although investment requirements of two different field nurseries for USDA Plant Hardiness Zones 5 and 6 conditions were examined, an infinite number of sizes could have been analyzed. Examination of the data indicate higher investment costs per unit of salable plant capacity would incur as field nursery size is decreased from the 50 acre one analyzed. This would be caused by spreading the cost of fixed items such as buildings, equipment, and machinery over fewer units. Conversely, lower costs per unit of salable plant capacity would be realized for field nurseries larger than the 200 acre nursery analyzed as the costs of fixed items would be spread over more units.

Individual nurserymen could, of course, incur somewhat different costs than those presented. Individual costs would depend upon variables such as production cycle chosen, labor productivity and ability to bargain with suppliers. The nurseryman also may choose not to provide for future expansion, choose land that would require minimum drainage modifications, reduce optimal growing/overwintering space requirements, rent land and/or equipment, and/or operate used equipment. This

analysis assumed average soil conditions, expansion capacity, optimal spacing configurations, new buildings, equipment and machinery.

Production Costs

Fixed

Annual fixed costs associated with capital including depreciation, interest, and taxes were $124,868 per year for the 50 acre nursery. In addition there was $102,960 allocated for general overhead and $6,678 for interest on general overhead, insurance and taxes resulting in a total of $234,506 total fixed costs for the 50 acre nursery (Table 5). These costs were divided equally between the five plant groups with each group receiving an assessment of $46,902 (Table 14). It was felt that the most reasonable way of assigning fixed cost is by area rather than plant. Once the physical facility is provided, fixed costs are incurred at essentially the same amount regardless of how the nursery facility is used.

On a per-salable-plant basic there was a considerable difference in annual fixed costs when they were differentiated by plant group (Table 15). In the 50 acre nursery, they were: $11.31 for Group I (Taxus), $8.08 for Group II (Juniperus), $7.56 for Group III (Viburnum), $25.09 for Group IV (Acer rubrum), and $17.16 for Group V (Malus). The average over all groups was $11.29. Annual fixed costs for group IV plants were more than three times as much as for group III. These costs were proportionate to the number of salable plants per annum produced

in allocated space. Fixed costs as a percentage of total costs ranged from 46% to 65% in the 50 acre nursery and averaged 55% for the five groups (Table 15).

For the 200 acre nursery, annual fixed costs associated with capital investment (depreciation, interest, insurance and taxes) were $270,110. An additional $163,425 was allocated for general overhead and $10,990 for interest on general overhead, insurance, and taxes making a total of $440,525 annual fixed costs for the 200 acre nursery (Table 5a). Assessment per plant group was $88,903 (Table 14a). Annual fixed costs per-salable-plant were: $4.90 for Group I, $3.48 for Group II, $3.27 for Group III, $10.87 for Group IV, and $7.43 for Group V and averaged $4.88 for all groups (Table 15a). Fixed costs as a percent of total costs were considerably lower than for the 50 acre nursery ranging from 30% to 52% and averaged 39% for all groups (Table 15a). This lower percentage was associated with the lower capital requirement per salable plant capacity.

Annual fixed costs per-salable-plant were substantially lower for the 200 acre nursery compared to the 50 acre. For Group I the difference was $6.41, for Group II $4.60, for Group III $4.29, for Group IV $14.22, and for Group V $9.73 and averaged $6.41 for all groups. This more than doubling in efficiency when going from the 50 acre to the 200 acre nursery is once again attributable to the more efficient use of buildings, machinery, and equipment of the large nursery over the small.

While many nurserymen and/or others concerned with the

industry might feel that the reported fixed cost figures ranging from 30% to 65% of total costs depending upon size of firm and species of plant might be high, these percentages would be in line with those for similar industries when considering new facilities. Brumfield et. al. (8) in a synthesized analyses of overhead costs of greenhouse firms found fixed (overhead) costs as a percent of sales to range from about 45% to over 67% depending on size of firm and market channel. The values of this study are not directly comparable with Brumfield et. al. (percent of total costs versus percent of sales). However, if marketing costs and potential profit were taken into account so that a direct comparison could be made, the fixed costs from the Brumfield study would be considerably higher as a percent of total costs than were reported in these analyses. Recent studies on nurseries, however, did show lower fixed costs as a percentage of total costs. Badenhop and Phillips (2), for USDA Plant Hardiness Zones 7 & 8, showed fixed costs ranging from 37% to 48% of total costs in a 50 acre nursery and from 27% to 36% in a 100 acre nursery. Most of the difference between the two studies could be accounted for by differences in budgeting. Bandenhop and Phillips did not provide for irrigation or drainage, two very expensive procedures provided for in this study. They also allocated less for nursery overhead. Finally, they used a different procedure for computing depreciation. For depreciation, they used the formula (((initial value + salvage value)/2) x 0.13). In this study we used the formula ((initial

value x .9)/years of estimated life). The salvage value was estimated at 10% of the initial value for all items. The Badenhop/Phillips procedure would show lower depreciation costs than would this study. Taylor, et. al., (14) in a study of container operations in USDA Plant Hardiness Zone 6 found fixed (overhead) costs as a percent of total costs to range from 37% to 51% depending on size of firm and number of salable plants. Analytical procedures in the Taylor, et. al., study were identical to this study. The major difference in that study vs. this study is in the number of salable plants produced per year. In the container study, a nursery containing approximately 8 acres of growing space would produce about 95,650 salable plants per year, and a nursery containing approximately 16 acres of growing space would produce about 192,095 salable plants per year. Therefore, fixed (overhead) costs were distributed over many more plants. Also capital requirements per salable plant capacity were much lower in the container nurseries. For the 8 acre (growing space) nursery, they ranged from $4.63 to $9.09 per capital requirement per salable plant capacity. In the 16 acre (growing space) nursery, they ranged from $3.71 to $7.39. As reported earlier, capital requirements per salable plant in this study ranged from $10.16 to $65.94 depending upon species of plant and size of field nursery. One of the major reasons for the large difference in capital requirements per salable plant capacity lies in the plant rotations. The container nursery operated on a two year rotation while the rotations for this

field study range from four years in the case of Group III (Viburnum) and Group V plants (Malus) to seven years in the case of Group I (Taxus) plants.

Nurserymen having established facilities might well consider annual fixed costs to be lower than those reported here. This is especially true if they calculate depreciation and repairs on the original value of land improvements, buildings, machinery and equipment and if they place a low value on their own management input. Good management for planning purposes, however, dictates computing depreciation and repairs on replacement value rather than on original cost. It also dictates placing a value on managerial time that would be comparable to salaries paid in competitive firms.

Variable

Annual variable costs differentiated by size of firm and plant group are detailed in Tables 8 thru 12a. There were substantial differences between plant groups, but little differenc by size of nursery.

Total variable costs for the 50 acre nursery for the small nursery by plant group were $25,524 for Group I (Taxus), $25,779 for Group II (Juniperus), $27,644 for Group III (Viburnum), $55,114 for Group IV (Acer rubrum), and $54,779 for Group V (Malus). Total for all groups was $188,840 (Table 14). The difference in total annual variable costs between groups is primarily accounted for by the cost of producing liners and in labor for harvesting. Liners for trees were purchased and were

much more expensive than liners for shrubs that were propagated. Also, trees require much more labor to harvest per unit than is the case for the shrub groups. On a per-salable-plant basic, annual variable costs were $6.16 for Group I, $4.44 for Group II,$4.44 for Group III, $29.50 for Group IV, and $20.06 for Group V and averaged $9.11 for all groups. Variable cost for the small nursery ranged from 35% to 58% of total costs and averaged 45% for all groups (Table 15).

For the 200 acre nursery variable costs by plant group were $81,524 for Group I, $91,476 for Group II, $103,079 for Group III, $202,260 for Group IV, and $206,687 for Group V. Total for all groups was $685,026 (Table 14a). On a per-salable-plant basis they were $4.49 for Group I, $3.59 for Group II, $3.79 for Group III, $24.74 for Group IV, $17.30 for Group V and averaged $7.55 for all groups (Table 15a). Variable costs for the large nursery ranged from 48% to 70% of total costs and averaged 61% for all groups.

While fixed cost differed substantially between sizes of nursery, the differential was less with variable costs. The difference for Group I was $1.67, for Group II $0.85, for Group III $0.65, for Group IV $4.76, and for Group V $2.76 and averaged $1.56 for all groups.

Total

Total annual costs are the summation of fixed and variable costs. For the 50 acre nursery they were $72,426 for Group I (Taxus), $72,681 for Group II (Juniperus), $74,546 for Group III

(Viburnum), $102,016 for Group IV (Acer rubrum), and $101,681 for Group V (Malus). For all groups they totaled $423,346 (Table 14). On a per-salable-plant basis they were $17.49 for Group I, $12.52 for Group II, $12.00 for Group III, $54.58 for Group IV, and $37.22 for Group V and averaged $20.40 for all groups (Table 15).

Total annual costs for the 200 acre nursery were $170,427 for Group I, $180,379 for Group II, $191,982 for Group III, $291,163 for Group IV, and $295,590 for Group V. They totaled $1,129,541 for all groups (Table 14a). On a per-salable-plant basis they were $9.39 for Group I, $7.07 for Group II, $7.06 for Group III, $35.61 for Group IV, and $24.73 for Group V and averaged $12.43 for all groups (Table 15a).

Differences in total annual costs per salable plant between the two sized nurseries were $8.08 for Group I, $5.45 for Group II, $4.94 for Group III, $18.97 for Group IV, and $12.49 for Group V and averaged $7.97 for all groups. Note that of the total differential, the majority was caused by differences in fixed costs. Overall, it was 39% less expensive to produce plants in the 200 acre nursery compared to the 50 acre ($12.43 per plant in the 200 acre nursery vs. $20.40 in the 50 acre). For fixed costs, the differential was 57% ($4.88 in the 200 acre nursery vs. $11.29 in the 50 acre) while for variable costs there was only a 17% advantage ($7.55 in the 200 acre nursery vs. $9.11 in the 50 acre). This means that fixed costs accounted for over 77% and variable costs less than 23% of the cost differentials

per-salable-plant between the two sized nurseries. For nurseries of the sizes analyzed, economies of size are achieved primarily in fixed rather than variable costs. Variable costs presented should be quite representative for Zones 5 and 6 nurseries doing a good job of management.

SUMMARY AND IMPLICATIONS

Large-size commercial field nurseries use buildings, equipment, and machinery more efficiently than small-sized field nurseries. As a result large nurseries have a lower cost per salable plant.

Total annual costs per salable plant in the 50 acre nursery differentiated by species ranged from $12.00 to $54.58 averaging $20.40 across species. In the large nursery comparable values were $7.06 to $35.61 averaging $12.43 across species. Over 77% of the differential noted between the two sizes of nurseries can be attributed to differences in fixed costs.

Fixed costs per salable plant in the 50 acre nursery ranged from $7.56 to $25.09 averaging $11.29. In the 200 acre nursery comparable costs were $3.27 to $10.87 averaging $4.88. The greater than 100% gain in efficiency when going from the 50 to 200 acre nursery is attributable to more efficient use of buildings, machinery, and equipment. Fixed costs as a percentage of total costs in the 50 acre nursery ranged from 46% to 65% averaging 55% across species. Comparable values for the 200 acre

nursery were 30%, 52%, and 39%. Differences in fixed costs among plant species were determined by a combination of space requirements and the number of years a plant would be in rotation.

Variable costs per salable plant showed differences among plant species and were also affected by size of nursery. In the 50 acre nursery they ranged from $4.44 to $29.50 and averaged $9.11 across species. Comparable figures for the 200 acre nursery were $3.59, $24.74 and $7.55. Major differences among species affecting variable costs were spacing requirements, cost of liners, and labor for harvesting. Variable costs as a percentage of total costs in the 50 acre nursery ranged from 35% to 58% averaging 45%. Comparable values for the 200 acre nursery were 48%, 70%, and 61%.

These figures demonstrated that variable costs per salable plant, while having wide variations among species, remain reasonably constant when comparisons are made between the two sized nurseries. The 50 acre nursery could purchase materials and other variable items almost as cheaply as could the 200 acre nursery. Fixed costs on a per-salable-plant basis, in contrast, changed significantly as size of nursery increased. This occurred because most of the fixed factors required to operate the 50 acre such as management, buildings, and most machinery and equipment were also adequate to operate the 200 acre nursery. As the size of nursery increased, costs for fixed items of production were spread over more salable units, thereby reducing

the fixed cost per-salable-plant.

Implications

A comparison of total annual costs of producing "B & B" plants in a 50 acre nursery in the field in USDA Plant Hardiness Zones 5 and 6 with prices in producers' wholesale catalogs would undoubtedly show selling prices lower than total annual costs. In fact, a comparison of costs with prices for the 200 acre field nursery would also, at best, show marginal returns. In fact, if one were to add costs of selling, very few producers would presently be charging enough to cover all costs, let alone profits. How then can producers continue to operate? The answer lies in how producers both experience and compute costs. We have used the economic and accounting method which includes both explicit and implicit costs. Explicit costs are those that are paid directly and easily determined, e.g. cost of liners, soil media, polyethylene, chemicals, labor, etc. Implicit costs are those that are more difficult to determine, such as the cost of equity capital and managerial capacities. The way these costs are determined varies significantly from firm to firm. Well-established nurseries are usually very accurate in determining explicit costs, but often do not consider all implicit costs. They base their costs on "cash flow" and profit and loss on "tax accounting." These established nurseries may have purchased land at low cost, be working with depreciated equipment and may be assigning low if any value to their management; in this case

determined costs would be at a much lower level than presented in this paper. Also, as pointed out earlier, careful site selection could significantly reduce fixed (overhead) costs. However, if one were to start a new container nursery, in a "normal" USDA Plant Hardiness Zone 5 or 6 site, costs would probably be very close to those presented here.

For the industry, selling nursery products for below "accounting costs" implies that well-established nurseries, operating essentially debt free, would have strong staying power whereas those who have just started or are heavily in debt may not be able to survive, especially if they are relaying on their field operation to meet all overhead expenses. Second, starting a field nursery (unless it were quite large) in USDA Plant Hardiness Zones 5 and 6 would probably not prove profitable unless items like buildings, equipment, machinery, management etc., could be shared with other enterprises or unless selling prices of nursery products in the zones increased substantially. At current prices for nursery products, this study shows that the return on investment for establishing new, independently operating, field nurseries in USDA Plant Hardiness Zones 5 and 6 would be marginal if not negative.

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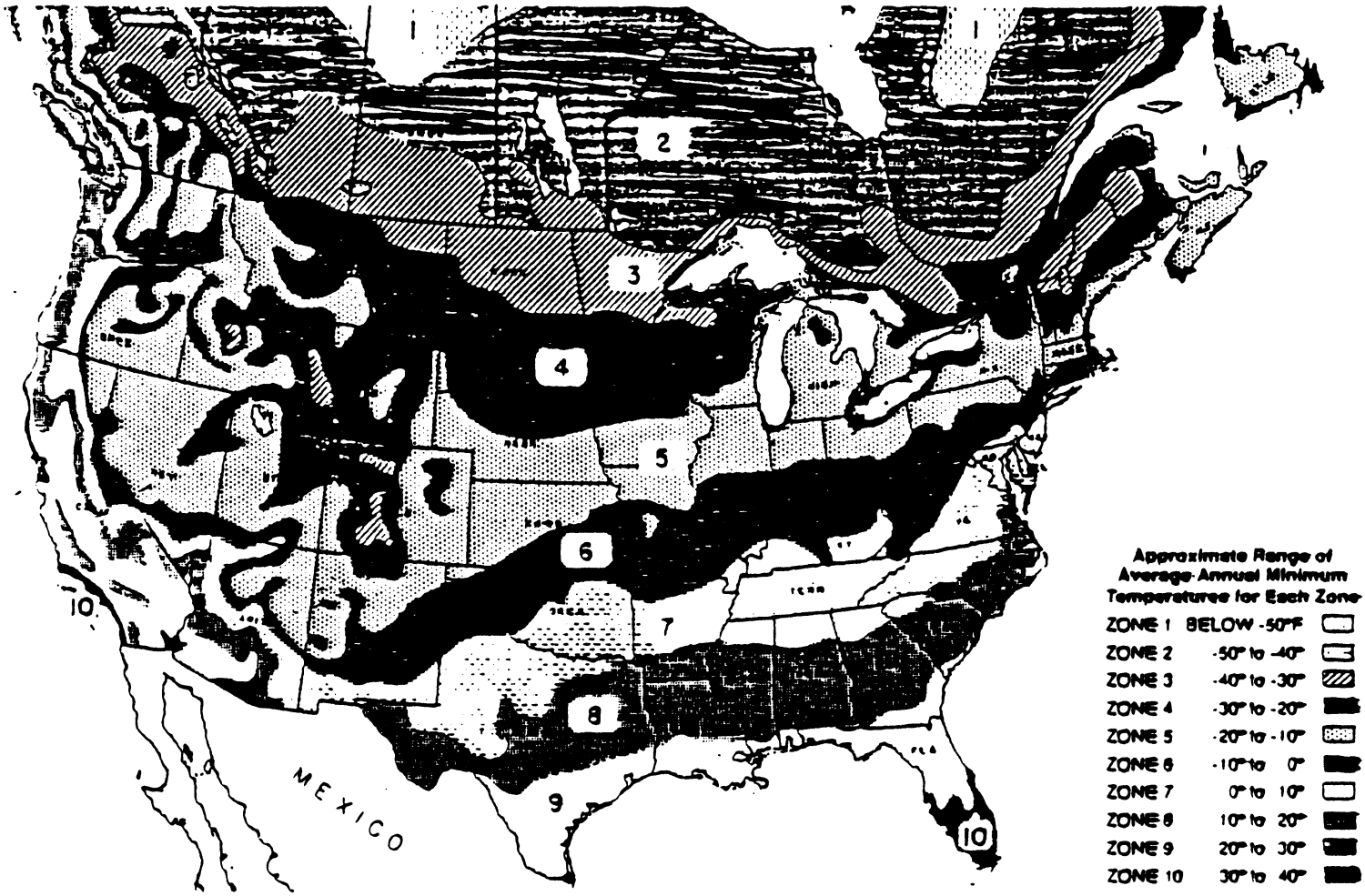
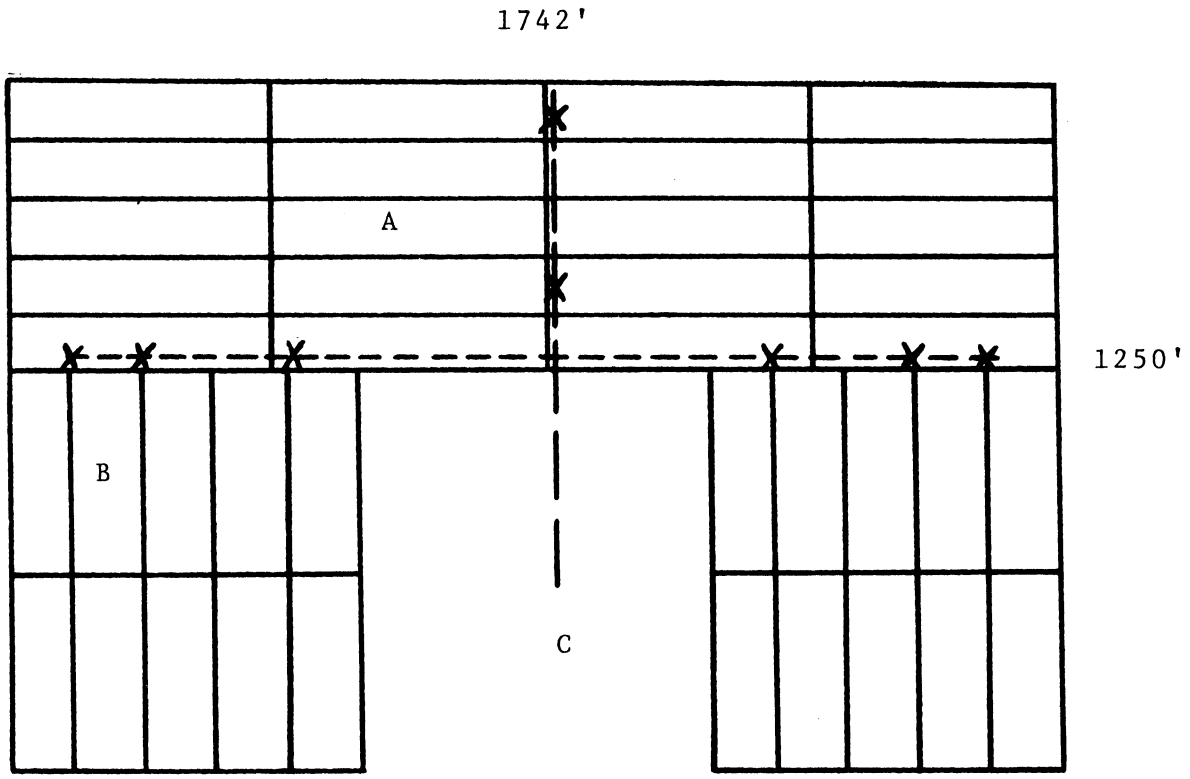


Figure 1. USDA plant hardiness zones

Source (15).

FIG. 2 - Schematic Drawing of a 50 Acre Field Nursery, U.S.D.A. Plant Hardiness Zone Six.



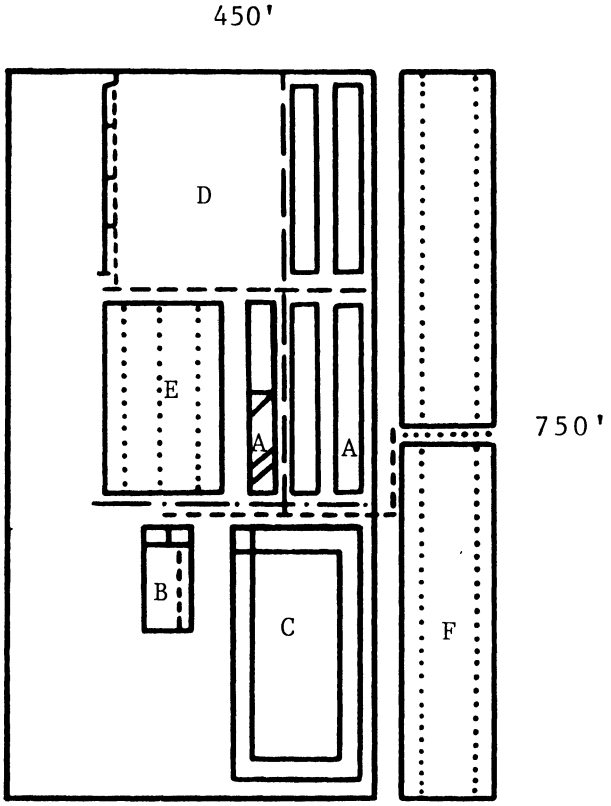
A. Growing plots (20) 100' x 435.6' (one acre)
B. Growing plots (20) 116.2' x 375' (one acre)
C. Production facilities, holding area, and field-bed area, 580' x 750'

X. Denotes placement of water hydrants for irrigation

6" PVC pipe – – – – –

8" PVC pipe ___ ___ ___

FIG. 3 - Schematic Drawing of a 50 Acre Field Nursery's Production Facilities, Holding Area, and Field-Bed Area, U.S.D.A. Plant Hardiness Zone Six.



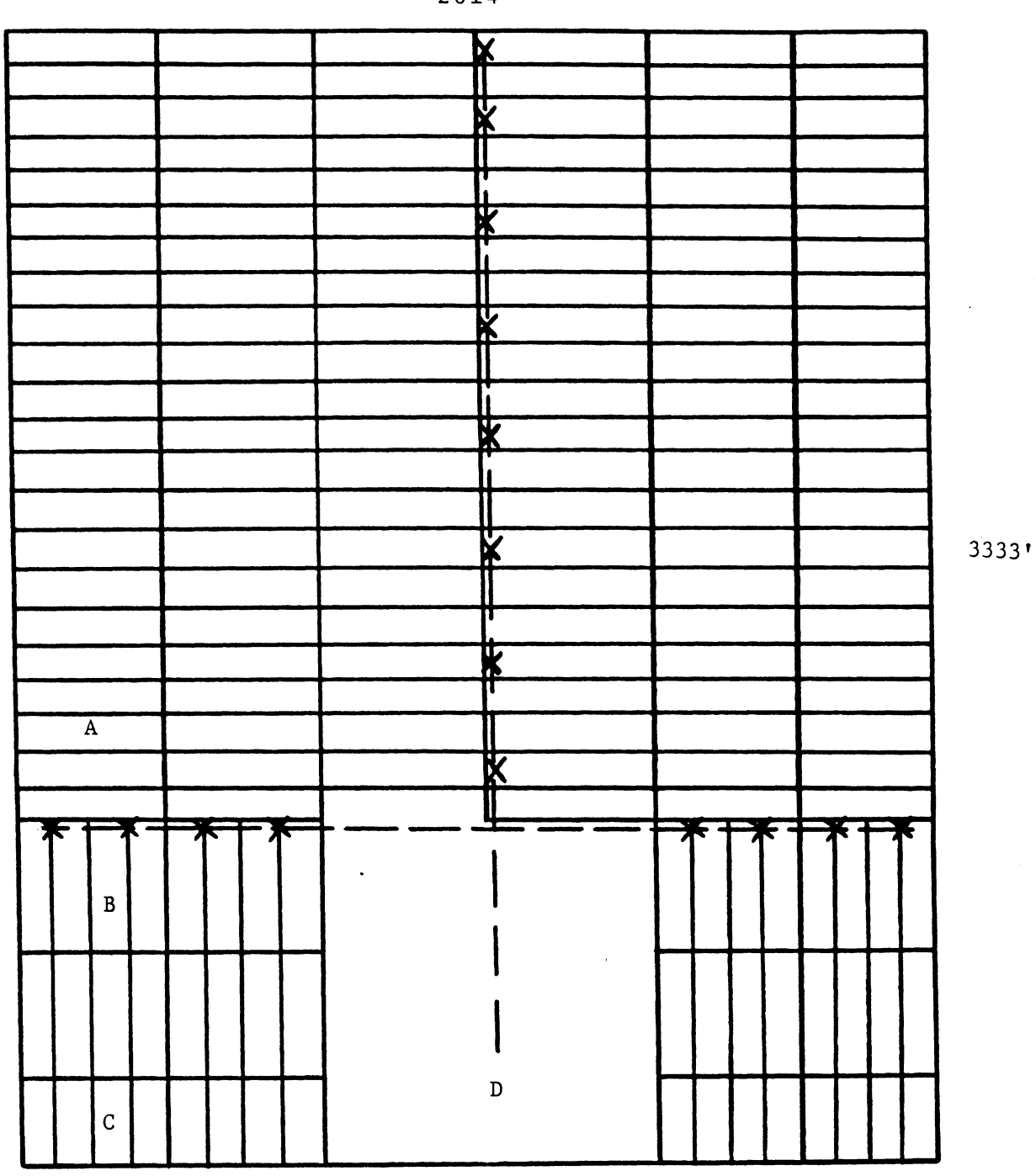
A. Polyhouse structure, 20' x 200'
A'. Propagation house, 20' x 100'
B. Supply shed, machinery storage, machine shop 40' x 100'
Office & restrooms 20' x 40'
C. Pond, 80' x 220' x 14' depth
Pump house, 10' x 10'
D. Shipping area, 100' x 200'
E. Holding area, 100' x 200'
F. Liner bed area, 125' x 333' each

Scale : 0' 200'

Drainage Tile, 30":
Watermain, 8" PVC :
Watermain, 6" PVC :
Watermain, 4" PVC :
Above ground irrigation pipe, 3" aluminum

Total acreage	= 450' x 750'	=	337,500 sq. ft. = 7.75 acres
Total polyhouse acreage	= 4 1/2 (20' x 200')	=	18,000 sq. ft. = 0.41 acres
Total propagation area	= 1/2 (20' x 200')	=	2,000 sq. ft. = 0.05 acres
Total holding acreage	= 100' x 200'	=	20,000 sq. ft. = 0.46 acres
Total liner bed acreage	= 2(125' x 330')	=	82,500 sq. ft. = 1.89 acres

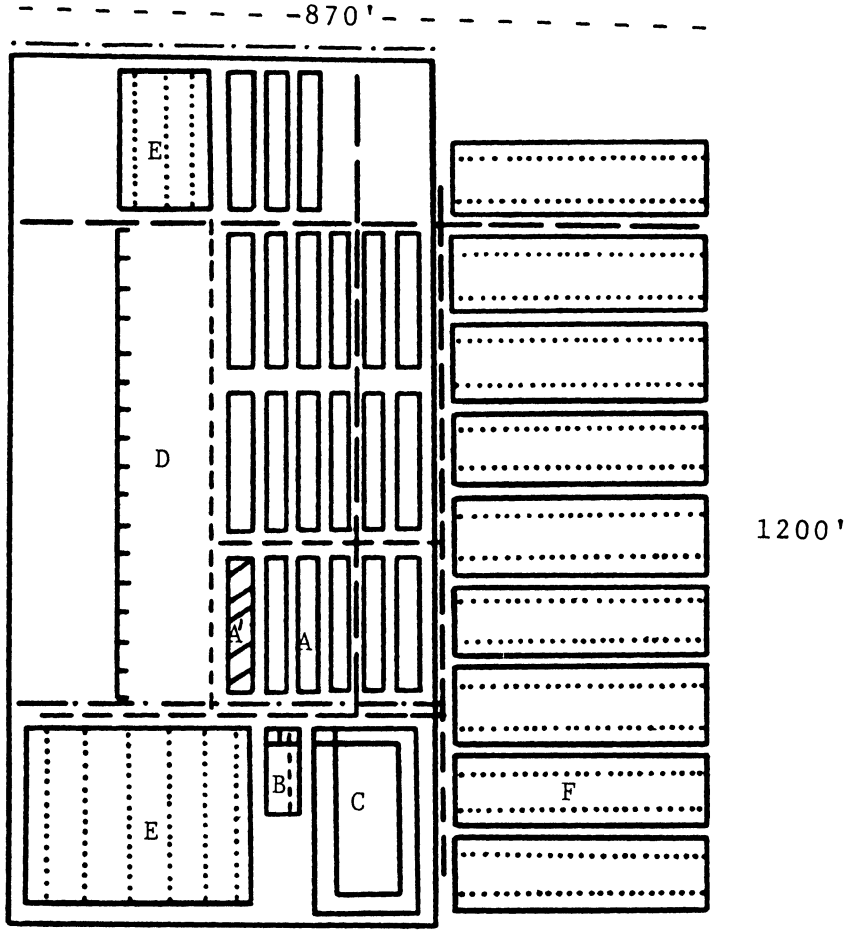
FIG. 4 - Schematic Drawing of a 200 Acre Field Nursery, U.S.D.A. Plant Hardiness Zone Six.



A. Growing plots (131) 100.0' x 435.6' (one acre)
B. Growing plots (32) 108.9' x 400.0' (one acre)
C. Growing plots (16) 108.9' x 300.0' (3/4 acre)
D. Production facilities, holding area, and field-bed area, 870' x 1200' (Note: one acre from this area was used as a growing plot.
X Denotes placement of water hydrants for irrigation.

6" PVC pipe – – – 8" PVC pipe —— —— ——

FIG. 5 - Schematic Drawing of a 200 Acre Field Nursery's Production Facilities, Holding Area, and Field-Bed Area, U.S.D.A. Plant Hardiness Zone Six.



A. Polyhouse structure, 20' x 200'
A'. Propagation house, 20' x 200'
B. Supply hed, machinery storage, machine shop 40' x 100'
Office & restrooms 20' x 40'
C. Pond, 80' x 220' x 14' depth
D. Shipping area, 10 semitruck loads
E. Holding area, (240' x 280') and (200' x 64')
F. Liner bed area, 100' x 330' each

Scale: 0' 200'

Drainage Tile, 30" :
Watermain, 8" PVC :
Watermain, 6" PVC :
Watermain, 4" PVC :
Above ground irrigation pipe, 3" aluminum

Total acreage	= 870' x 1200'	=	1,044,000 sq. ft. =	23.97 acres
Total polyhouse acrease	= 20(20' x 200')	=	80,000 sq. ft. =	1.84 acres
Total propagation area	= 20' x 200'	=	4,000 sq. ft. =	.09 acres
Total holding acreage	= (240' x 280') + (200' x 64'	=	80,000 sq. ft. =	1.84 acres
Total liner bed acreage	= 9(100' x 330')	=	297,000 sq. ft. =	6.82 acres

TABLE 1.--Capital Requirements for a 50 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985

Item	Description**	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land	Unimproved land	acre	--	50	2,000	100,000	16
+ Improvements	Grading, tiling, graveling, pond		20			115,156	19
Subtotal						215,156	35
Buildings							
Office and restrooms	20′ x 40′	sq ft	20	800	35	28,000	5
Plant and supply storage	40′ x 50′	sq ft	20	2000	20	40,000	6
Machinery storage and shop	40′ x 50′	sq ft	20	2000	20	40,000	7
Polyhouse structures	200′ x 20′	each	10	5	2,761	13,805	2
Subtotal						121,805	20
Machinery and Equipment							
Tractor, 75 HP	75 HP, diesel fuel	each	10	1	28,278	28,278	5
Tractor, 34 HP	34 HP, gas fuel	each	10	2	14,504	29,008	5
Articulated 4-Wheel Drive Loader	Swinger 320 - lift cap. = 3,000 lbs.	each	10	1	38,000	38,000	6
Tree spade	530P Handles 20",22",&24" + lift pads	each	2	1	8,490	8,490	1
Forks	For front-end loaders	each	10	1	1,100	1,100	***
Plow	3-14 inch plows	each	10	1	2,616	2,616	***
Disk	8′ wide	each	10	1	3,900	3,900	1
Harrow	10′ wide	each	10	1	650	650	***
Cultimulcher - bed area	10′ wide	each	10	1	3,800	3,800	1
Sprayrig (boom sprayer)	100 gallon tank with 7′ & 10′ booms	each	7	1	1,407	1,407	***
Transplanter, 3 row	3-20 inch row bed transplanter	each	10	1	7,500	7,500	1
Transplanter, 1 row	Tree planter	each	10	1	5,000	5,000	1
Permanent irrigation/well pump	100HP electric pump	each	20	1	36,396	36,396	6
Inground irrigation/bed area	PVC pipe/valves		20		11,064	11,064	2
Above ground irrigation/bed area	Aluminum pipe/valves/sprinklerheads		5		1,829	1,829	***
Inground irrigation storage/holding	PVC pipe/valves		20		6,904	6,904	1
Above ground irr. storage/holding	Aluminum pipe/valves/sprinklerheads		5		2,405	2,405	***
Traveler gun - field irrigation	450-500 gallons per minute		10	1	22,000	22,000	4
Portable irr. pump (emergency)	40 HP P.T.O irrigation pump/foot valve	each	10	1	425	425	***
Airblast sprayer-"Myer"	300 gallon high pressure on trailer	each	7	1	3,600	3,600	1
Fertilizer injector	26 gallon injector - bed use	each	5	2	858	1,716	***
Transplanter, 2 row	2-42/48" row field transplanter	each	10	1	5,600	5,600	1
U Blade - field	18" for undercutting	each	5	1	240	240	***
Undercutter - bed	Bed undercutter, 50" blade, lift tines	each	7	1	285	285	***
Fertilizer sidedresser	2 row sidedresser	each	10	1	1,000	1,000	***
Cultivator, 2 row	2 row field cultivator	each	7	1	1,700	1,700	***
Wagon	4 wheel, farm wagon	each	10	4	1,978	7,912	1
Cultivator, 3 row	3 row bed cultivator	each	7	1	2,250	2,250	***
Truck	1/2 ton pickup truck	each	5	1	13,485	13,485	2

Table 1 Cont.

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Pallets	Wooden	each	2	181	12	2,172	***
Handtools	Miscellaneous	sets	5	20	100	2,000	***
Seeder	Broadcast Seeder		10	1	175	175	***
Mower	7' - 3 blade mower		10	1	2,283	2,283	***
Flatbed Truck****	24 ft Flatbed, gas fuel		5	1/2	42,000	21,000	3
Heating system for propagation							
Gas Fired unit heater - Modine	200,000 BTU (input)	each	10	1	1,104	1,104	***
Fan jet	Acme	each	10	1	103	103	***
Thermostat	Two stage	each	10	1	44	44	***
Set-up for propane*****	Vent., reg., etc.	each	10	1	100	100	***
Set-up for heating system	Plywood, braces, bolts, etc.	each	10	1	100	100	***
Other propagation materials							
Misting system	Mist-a-matic	each	2	3	249	747	***
Pipe and nozzels	For misting system		2	1	300	300	***
Treated boards	5/4" x 8" x variable length	foot	2	330	0.74	244	***
Heating cable	Propagation	foot	2	900	0.35	315	***
Subtotal						279,247	45
TOTAL						616,208	100

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc.

**For details on individual items see the following tables: land improvements - Table 2; polyhouse construction - Table 3; overall irrigation system - Table 4; irrigation for winter storage and holding area - Table 4a; irrigation for bed and field - Table 4b; well and electric pump - Table 4c.

***Less than 1/2 of 1%.

****One-half the cost of a flatbed truck was budgeted for the small nursery's field production.

*****Propane tanks, connectors, etc. will be leased from the company supplying propane.

TABLE 1a.--Capital Requirements for a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Description**	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land	Unimproved land	acre	--	200	2,000	400,000	29
+ Improvements	Grading, tiling, graveling, pond		20			284,210	21
Subtotal						684,210	50
Buildings							
Office and restrooms	20′ x 40′	sq ft	20	800	35	28,000	2
Plant and supply storage	40′ x 50′	sq ft	20	2000	20	40,000	3
Machinery storage and shop	40′ x 50′	sq ft	20	2000	20	40,000	3
Polyhouse structures	200′ x 20′	each	10	21	2,761	57,981	4
Subtotal						165,981	12
Machinery and Equipment							
Tractor, 75 HP	75 HP, diesel fuel	each	10	1	28,278	28,278	2
Tractor, 60 HP	60 HP, diesel fuel	each	10	1	20,419	20,419	1
Tractor, 34 HP	34 HP, gas fuel	each	10	4	14,504	58,016	4
Articulated 4-Wheel Drive Loader	Swinger 220 - Lift cap. = 2,000 lbs.	each	10	2	25,000	50,000	4
Articulated 4-Wheel Drive Loader	Swinger 320 - lift cap. = 3,000 lbs.	each	10	2	38,000	76,000	6
Tree spade	530P Handles 20",22", & 24" + liftpads	each	2	2	8,490	16,980	1
Forks	For front-end loaders	each	10	4	1,100	4,400	***
Plow	3-14 inch plows	each	10	1	2,616	2,616	***
Disk	8′ wide	each	10	1	3,900	3,900	***
Harrow	10′ wide	each	10	1	650	650	***
Cultimulcher - bed area	10′ wide	each	10	1	3,800	3,800	***
Sprayrig (boom sprayer)	100 gallon tank with 7′ & 10′ booms	each	7	1	1,407	1,407	***
Transplanter, 3 row	3-20 inch row bed transplanter	each	10	1	7,500	7,500	1
Transplanter, 1 row	Tree planter	each	10	1	5,000	5,000	***
Permanent irrigation/well pump	100HP electric pump	each	20	1	36,396	36,396	3
Inground irrigation/bed area	PVC pipe/valves		20		34,606	34,606	3
Above ground irrigation/bed area	Aluminum pipe/valves/sprinklerheads		5		4,347	4,347	***
Inground irrigation storage/holding	PVC pipe/valves		20		17,959	17,959	1
Above ground irr. storage/holding	Aluminum pipe/valves/sprinklerheads		5		8,286	8,286	1
Traveler gun - field irrigation	450-500 gallons per minute		10	1	22,000	22,000	2
Portable irrigation pump	40 HP P.T.O irrigation pump/foot valve	each	10	1	425	425	***
Airblast sprayer-"Myer"	300 gallon high pressure on trailer	each	7	1	3,600	3,600	***
Fertilizer injector	26 gallon injector	each	5	2	858	1,716	***
Transplanter, 2 row	2-42/48" row field transplanter	each	10	1	5,600	5,600	***
U Blade - field	18" for undercutting	each	5	1	240	240	***
Undercutter - bed	Bed undercutter, 50" blade, lift tines	each	7	1	285	285	***
Fertilizer sidedresser	2 row sidedresser	each	10	1	1,000	1,000	***
Cultivator, 2 row	2 row field cultivator	each	7	2	1,750	3,500	***
Wagon	4 wheel, farm wagon	each	10	8	1,978	15,824	1
Cultivator, 3 row	3 row bed cultivator	each	7	1	2,250	2,250	***
Truck	1/2 ton pickup truck	each	5	2	13,485	26,970	2

Table 1a Cont.

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Pallets	Wooden	each	2	482	12	5,784	***
Handtools	Miscellaneous	sets	5	76	100	7,600	1
Seeder	Broadcast Seeder		10	1	175	175	***
Mower	7' - 3 blade mower		10	1	2,283	2,283	***
Flatbed Truck	24 ft. flatbed, gas fuel		5	1	42,000	42,000	3
Heating system for propagation							
Gas fired unit heater - Modine	200,000 BTU (input)	each	10	2	1,104	2,208	***
Fan jet - Acme		each	10	2	103	206	***
Thermostat	Two stage	each	10	2	44	88	***
Set-up for propane****	Vent., reg., etc.	each	10	2	100	200	***
Set-up for heating system	Plywood, braces, bolts, etc.	each	10	2	100	200	***
Other propagation materials						1,494	
Misting system	Mist-a-matic	each	2	6	249	494	***
Pipe and nozzles	For misting system		2	2	300	600	***
Treated boards	5/4" x 8" x variable length	foot	2	1,320	0.74	977	***
Heating cable	Propagation	foot	2	3,600	0.35	1,260	***
Subtotal						529,045	38
TOTAL						1,379,236	100

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc.
**For details on individual items see the following tables: land improvements - Table 2; polyhouse construction - Table 3; overall irrigation system - Table 4; irrigation for winter storage and holding area - Table 4a; irrigation for bed and field - Table 4b; well and electric pump - Table 4c.
***Less than 1/2 of 1%.
****Propane tanks, connectors, etc. will be leased from the company supplying propane.

TABLE 2.--Land Improvement Costs for a 50 and 200 acre Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Unit	Cost per Unit (dollars)	50 Acre Field Nursery* Quantity (units)	50 Acre Field Nursery* Total Cost (dollars)	200 Acre Field Nursery** Quantity (units)	200 Acre Field Nursery** Total Cost (dollars)
Grading						
Grading of land and pond top soil removal, 410.0 cu yd. per acre @ $2.00 per cu. yd.	acre	820***	5.60	4,592	13.64	11,185
Grading including cutting and filling, 900 cu. yd. per acre @ $1.75 per cu. yd.	acre	1,575	5.60	8,820	13.64	21,483
Grading for pond				22,815		22,815
Subtotal				36,227		55,483
Tiling (water drainage)						
Central production facilities 30" cement pipe @ $16.59/ft. Installation labor @ $11.41/ft.	foot	28	900.00	25,200	1,450.00	40,600
Bed area 4" plastic tile, 30' on center, herringbone design, 42" depth	acre	750	1.89	1,418	6.82	5.115
Field area 4" plastic tile, 30' on center, herringbone design, 42" depth	acre	750	42.25	31,688	176.00	132,000
Subtotal				58,306		177,715
Graveling						
Production area within polyhouse structures, 20' x 200', 3" depth of #8 gravel = 37.04 cu. yd. per polyhouse or 37.04 ton @ $7.80 /ton delivered and spread	polyhouse	7.80	185.20	1,445	778.00	6,068
Area between polyhouse structures, 4" depth of #4 gravel = 49.38 cu. yd. or 49.38 ton per 20' x 200' section @ $7.80 /ton delivered and spread	20' x 200' section	7.80	148.14	1,155	629.68	4,912
Production area excluding grass, growing areas, pond - 4" depth of #4 gravel = 532.4 cu. yd. or 532.4 ton per acre @ $7.80/ ton delivered and spread	acre	4,152.72	4.34	18,023	9.64	40,032
Subtotal				20,623		51,012
TOTAL				115,156		284,210

*50 acres total; 7.75 acres of production facilities, holding and field-bed area.
**200 acres total; 21.73 acres of production facilities, holding and field-bed area.
***Soil removed for grading was not sold, rather it was placed in the field area.

TABLE 3.--Cost of Polyhouse Construction for a 50 and 200 Acre Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985

Item	Cost per Item (dollars)	Number of Items per Polyhouse	Cost per Polyhouse (dollars)	50 Acre Field Nursery* Number of Polyhouses	50 Acre Field Nursery* Total Cost (dollars)	200 Acre Field Nursery** Number of Polyhouses	200 Acre Field Nursery** Total Cost (dollars)
Polyhouse framework - 20′ x 200′							
Galvanized steel pipe							
Arches, 3/4" x 32′ lengths @ $0.57 ft.	18.24	51 ea	930	5	4,650	21	19,530
Ground Inserts, 1" x 4.2′ @0.75 ft.	3.15	102 ea	321	5	1,605	21	6,741
Threaded ridge line, 3/4" x 200′ @ $0.57	114.00	1 ea	114	5	570	21	2,394
End braces, 3/4" x 32′ @ $0.57 ft.	18.24	4 ea	73	5	365	21	1.533
Subtotal			1,438		7,190		30,198
Hardware							
Bolts for connecting arches and ground inserts, 3" x 3/4"	0.12	102 ea	12	5	60	21	252
Hinges, 3" rustproof	1.20	12 ea	14	5	70	21	294
Door latch, hasp	4.00	2 ea	8	5	40	21	168
Subtotal			34		170		714
Wood - treated white pine							
1 1/4" x 8" x roughcut 3 graded or better	0.74	440 ft.	326	5	1,630	21	6,846
2" x 4" x 8′ rough	3.31	4 ea.	13	5	65	21	273
2" x 4" x 12′ rough	4.96	4 ea.	20	5	100	21	420
1" x 6" x 8′ rough	2.60	4 ea.	10	5	50	21	210
1" x 6" x 12′ rough	3.95	4 ea.	16	5	80	21	336
2" x 2" x 8′ finished	2.14	5 ea.	11	5	55	21	231
Subtotal			396		1,980		8,316
Labor requirements	6.93***	100 hrs.	693	5	3,465	21	14,553
Miscellaneous			200	5	1,000	21	4,200
TOTAL			2,761 ****		13,805		57,981

*50 acres Total; 20,000 sq ft of polyhouse space.

**200 acres total; 84,000 sq ft of polyhouse space.

***Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

****Approximately $0.69 per square foot.

TABLE 4. Cost of Irrigation System for a 50 and 200 Acre Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	50 Acre Field Nursery* Total Cost (dollars)	200 Acre Field Nursery** Total Cost (dollars)
Winter Storage and Holding Area***		
Inground irrigation system	6,904	16,957
Above ground irrigation system		
Polyhouse structures	1,072	4,101
Holding area	1,333	4,185
Subtotal (Winter storage and holding area)	9,309	25,243
Field/Bed Irrigation****		
Inground irrigation system	11,064	34,606
Above ground irrigation system	1,829	4,345
Traveler gun	22,000	22,000
Subtotal (field irrigation)	34,893	60,951
TOTAL (Not including well and pump)	44,202	86,194
Cost of well*****	13,500	13,500
Cost of pump*****	22,896	22,896
Total for irrigation system	80,598	122,590

*50 acres total
**200 acres total
***For details, see Table 4a.
****For details, see Table 4b.
*****For details, see Table 4c.

TABLE 4a. Cost of Irrigation System for the Winter Storage and Holding Area for a 50 and 200 Acre Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Unit	Cost Per Unit (dollars)	50 Acre Field Nursery* Quantity Needed	50 Acre Field Nursery* Total Cost (dollars)	200 Acre Field Nursery** Quantity Needed	200 Acre Field Nursery** Total Cost (dollars)
Inground Irrigation System						
8" pipe, PVC	foot	3.98	506	2,014	1,656	6,591
6" pipe, PVC	foot	2.34	640	1,498	1,089	2,548
4" pipe, PVC	foot	1.24	379	470	1,114	1,381
2" pipe, PVC	foot	0.46	36	17	124	57
Additional required equipment, estimated at 20% of pipe value				800		3,706
Installation charges						
for 6" and 8" pipe	foot	1.35	1,146	1,547	2,745	3,706
for 2" and 4" pipe	foot	1.26	443	558	1,238	1,560
Subtotal				6,904		17,959
Above Ground Irrigation System						
1. Polyhouse structures-storage						
1-frost free hydrant 1" @ $60.00						
200 ft of 1" PVC pipe @ $0.22/foot = $44.00						
Installation labor/parts, estimated at 30% of pipe cost = $13.20						
10-rotating sprinklers, Nelson Whizhead 5/64" nozzels @ $4.95 = $49.50	polyhouse	166.70	5	1,072***	21	4,101***
2. Holding area						
3" pipe, latchless aluminum	foot	1.57	600	942	2,080	3,266
Additional fittings 20% of pipe cost				188		208
Pipe riser 3/4" diameter x 48"	each	5.30	10	53	35	186
Rotating sprinkler, #30BH Rainbird, Nozzle size 5/32" x 3/32"	each	15.00	10	150	35	525
Subtotal (Above ground irrigation system for storage and holding area)				2,405		8,286
Total				9,309		26,245

*50 acres total

**200 acres total

***Cost includes extra frost free hydrants used in other areas.

TABLE 4b. Cost of Bed and Field Irrigation for a 50 and 200 Acre Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Unit	Cost Per Unit (dollars)	50 Acre Field Nursery* Quantity Needed	50 Acre Field Nursery* Total Cost (dollars)	200 Acre Field Nursery** Quantity Needed	200 Acre Field Nursery** Total Cost (dollars)
Field/Bed Irrigation						
Inground Irrigation System						
8" pipe, PVC mainline pipe	foot	3.98	450	1,791	4,372	17,401
6" pipe, PVC mainline pipe	foot	2.24	1,659	3,716	1,008	2,359
4" pipe, PVC upright pipe	foot	1.24	4	5	64	79
Hydrant	each	180.00	8	1,440	16	2.880
Additional required equipment, estimated at 20% of pipe & hydrant value				1,330		4,544
Installation charges						
for 6" and 8" pipe	foot	1.35	2,056	2,777	5,380	7,263
for 4" pipe	foot	1.26	4	5	64	80
Subtotal (inground irrigation system)				11,064		34,606
Above Ground Irrigation System						
3" pipe, Aluminum portable latchless	foot	1.57	820	1,287	1,940	3,046
Additional required equipment, estimated at 20% of pipe value				258		609
Sprikler risers 3/4" x 48"	each	5.30	14	74	34	180
Rotating sprinkler, #30BH Rainbird, nozzle size 5/32" x 3/32"	each	15	14	210	34	510
Subtotal (above ground irrigation system)				1,829		4,345
Traveler Gun 450-500 gpm	each	22,000	1	22,000	1	22,000
TOTAL BED AND FIELD IRRIGATION				34,893		60,951

*50 acres total
**200 acres total

TABLE 4C. Specifications and Costs of Installing a 100H.P. Electric Well Pump and an 80 Foot Well, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Specifications	Total Cost (dollars)
Pump - above ground, 100 HP* lineshaft, 1,800 RPM	
Basic electric motor	4,087
Discharge head, 8"	1,196
Standard 10' length, column, 80' depth assembly 8" x 1 1/2"	4,325
Suction pipe, 8" x 10'	340
Pump bowl assembly -3 stage, 12" pump	2,688
Air line guage and air line	45
Well seal, well plate, cement	350
Electrical equipment	88
Installation fee	1,000
Right angle gear drive, auxillary power source using a tractor	2,986
Subtotal	17,105
+ Freight @ 10%	1,791
+ Building	4,000
Total cost for pump, including shelter	22,896
Well Drilling	
Casting diameter, 14" O.D.	13,500
Total cost for well	13,500
TOTAL	36,396

*A 100H.P. pump can supply 900 gallons per minute of water at 65 psi given the specifications and site location.

Table 5. Annual Fixed Costs (Dollars) for a 50 acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Description	Depreciation**	Interest***	Insurance and Taxes****	Total
Land	Unimproved land	--	12,000	2,000	14,000
+ Improvements	Grading, tiling, graveling, pond	5,182	13,819	2,303	21,304
Subtotal		5,182	25,819	4,303	35,304
Buildings					
Office and restrooms	20′ x 40′	1,260	3,360	685	5,305
Plant and supply storage	40′ x 50′	1,800	4,800	978	7,578
Machinery storage and shop	40′ x 50′	1,800	4,800	978	7,578
Polyhouse structures	200′ x 20′	1,242	1,657	338	3,237
Subtotal		6,102	14,617	2,979	23,698
Machinery and Equipment					
Tractor, 75 HP	75 HP, diesel fuel	2,545	3,393	107	6,045
Tractor, 34 HP	34 HP, gas fuel	2,611	3,481	110	6,202
Articulated 4 Wheel Drive Loader	Swinger 320 - lift cap. = 3,000lbs	3,420	4,560	144	8,124
Tree spade	530P Handles 20",22",&24" + lift pads	3,821	1,019	32	4,872
Forks	For front end loaders	99	132	4	235
Plow	3 - 14 inch plows	235	314	10	559
Disk	8′ wide	351	468	15	834
Harrow	10′ wide	59	78	2	139
Cultimulcher - bed area	10′ wide	342	456	14	812
Sprayrig (boom sprayer)	100 gallon tank with 10′ boom	181	169	5	355
Transplanter, 3 row	3-20 inch row bed transplanter	675	900	28	1,603
Transplanter, one row	Tree planter	450	600	19	1,069
Permanent irrigation/well pump	100 HP electric pump	1,638	4,368	138	6,144
Inground irrigation/bed area	PVC pipe/valves	498	1,328	42	1,868
Above ground irrigation/bed area	Aluminum pipe/valves/sprinklerheads	329	220	7	556
Inground irrigation storage/holding	PVC pipe/valves	311	829	26	1,166
Above ground irr. storage/holding	Aluminum pipe/valves/sprinklerheads	433	289	9	731
Traveler gun - field irrigation	450-500 gallons per minute	1,980	2,640	83	4,703
Portable irrigation pump	40 HP P.T.O irrigation pump/foot valve	38	51	2	91
Airblast sprayer - "Myer"	300 gallon high pressure on trailer	463	432	14	909
Fertilizer injector	26 gallon injector - bed use	309	206	6	521
Transplanter, 2 row	2-42 inch row field transplanter	504	672	21	1,197
U Blade - field	18" for undercutting	43	29	1	73
Undercutter - bed	Bed undercutter, 50" blade, lift tines	37	34	1	72
Fertilizer sidedresser	2 row sidedresser	90	120	4	214
Cultivator, 2 row	2 row field cultivator	219	204	6	429
Wagon	4 wheel, farm wagon	712	949	30	1,691
Cultivator, 3 row	3 row bed cultivator	289	270	9	568
Truck	1/2 ton pickup truck	2,427	1,618	51	4,096
Pallets	Wooden	977	261	8	1,246
Handtools	Miscellaneous	360	240	8	608
Seeder	Broadcast seeder	16	21	1	38
Mower	7′ - 3 blade mower	205	274	9	488

Table 5 Con't

Item	Description	Depreciation**	Interest***	Insurance and Taxes****	Total
Flatbed Truck	24 ft. flatbed, gas fuel	3,780	2,520	79	6,379
Heating System for Propagation					
Gas fired unit heater - Modine	200,000 BTU (input)	99	132	4	235
Fan jet - Acme		10	12	#	22
Thermostat	Two stage	4	5	#	9
Set-up for propane	Vent., reg., etc.	9	12	#	21
Set-up for heating system	Plywood, braces, bolts, etc.	9	12	#	21
Other propagation materials					
Misting system	Mist-a-matic	336	90	3	429
Pipe and nozzles	For misting system	135	36	1	172
Treated boards	5/4" x 8" x variable length	110	29	1	140
Heater cable		141	38	1	180
Subtotal		31,300	33,511	1,055	65,866
Total for Depreciation, Interest, Insurance and Taxes		42,584	73,947	8,337	124,868
General Overhead					
Utilities	Telephone, electric, gas heat				6,200
Licenses and bonds					400
General repairs and maintenance	Buildings, grounds, roads				7,060
Advertising and printing					1,200
Insurance, personnel##	Workmen's comp., FICA, health, unemp.				19,200
Travel and professional fees					1,900
Administrative and management###	Clerical, operator, supervisory, labor and office supplies				66,000
Miscellaneous					1,000
Subtotal					102,960
Interest on General Overhead, Insurance and Taxes	12% per annum for 6 months on a total of $111,297				6,678
Total Annual Fixed Costs					234,506

*Fifty acre total, 40 acres growing space, 10 acres production facilities, holding area, field bed area, roads, etc.

**Depreciation was estimated by dividing initial cost adjusted for a 10% salvage value, by the years of useful life.

***Interest costs were estimated by multiplying the initial value of land, building, equipment and machinery by the interest rate, 12% per annum.

****Insurance and taxes.

Land and improvements--Only taxes are assessed, at a rate of $20.00 per $1000.00 of market value.

Buildings--Taxes assessed at a rate of $20.00 per $1000.00 of market value. Insurance, $500.00 deductible, at $4.46 per $1000.00 of market value. Total for category, $24.46 per $1000.00.

Machinery and equipment--Taxes are not assessed in state of Ohio on personal property. Insurance, $500.00 deductible, at $3.78 per $1000.00 of initial value.

#Less than $0.50.

##Insurance for personnel was estimated at 32% of salaries for owner/operator, supervisor, and clerical.

###Owner/operator = $30,000, Supervisor = $20,000, Clerical = $10,000, Supplies 10% or $6,000. Total = $66,000.

Table 5a. Annual Fixed Costs (Dollars) for a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985

Item	Description	Depreciation**	Interest***	Insurance and Taxes****	Total
Land	Unimproved land	--	48,000	8,000	56,000
+ Improvements	Grading, tiling, graveling, pond	12,789	34,105	5,684	52,578
Subtotal		12,789	82,105	13,684	108,578
Buildings					
Office and restrooms	20′ x 40′	1,260	3,360	685	5,305
Plant and supply storage	40′ x 50′	1,800	4,800	978	7,578
Machinery storage and shop	40′ x 50′	1,800	4,800	978	7,578
Polyhouse structures	200′ x 20′	5,218	6,958	1,418	13,594
Subtotal		10,078	19,918	4,059	34,055
Machinery and Equipment					
Tractor, 75 HP	75 HP, diesel fuel	2,545	3,393	107	6,045
Tractor, 60 HP	60 HP, diesel fuel	1,838	2,450	77	4,365
Tractor, 34 HP	34 HP, gas fuel	5,221	6,962	219	12,402
Articulated 4-Wheel Drive Loader	Swinger 220 - lift cap. = 2,000lbs	4,500	6,000	189	10,689
Articulated 4-Wheel Drive Loader	Swinger 320 - lift cap. = 3,000lbs	6,840	9,120	287	16,247
Tree spade	530P Handles 20",22", & 24" + liftpads	7,641	2,038	64	9,743
Forks	For front-end loaders	396	528	17	941
Plow	3 - 14 inch plows	235	314	10	559
Disk	8′ wide	351	468	15	834
Harrow	10′ wide	59	78	2	139
Cultimulcher - bed area	10′ wide	342	456	14	812
Sprayrig (boom sprayer)	100 gallon tank with 10′ boom	181	169	5	355
Transplanter, 3 row	3-20 inch row bed transplanter	675	900	28	1,603
Transplanter, one row	Tree planter	450	600	19	1,069
Permanent irrigation/well pump	100 HP electric pump	1,638	4,367	138	6,143
Inground irrigation/bed area	PVC pipe/valves	1,557	4,153	131	5,841
Above ground irrigation/bed area	Aluminum pipe/valves/sprinklerheads	782	522	16	1,320
Inground irrigation storage/holding	PVC pipe/valves	808	2,155	68	3,031
Above ground irr. storage/holding	Aluminum pipe/valves/sprinklerheads	1,491	994	31	2,516
Traveler gun - field irrigation	450-500 gallons per minute	1,980	2,640	83	4,703
Portable irrigation pump	40 HP P.T.O irrigation pump/foot valve	38	51	2	91
Airblast sprayer - "Myer"	300 gallon high pressure on trailer	463	432	14	909
Fertilizer injector	26 gallon injector	307	205	6	518
Transplanter, 2 row	2-42 inch row field transplanter	504	672	21	1,197
U-Blade - field	18" for undercutting	43	29	1	73
Undercutter - bed	Bed undercutter, 50" blade, lift tines	37	34	1	72
Fertilizer sidedresser	2 row sidedresser	90	120	4	214
Cultivator, 2 row	2 row field cultivator	450	420	13	883
Wagon	4 wheel, farm wagon	1,424	1,899	60	3,383
Cultivator, 3 row	3 row bed cultivator	289	270	9	568
Truck	1/2 ton pickup truck	4,855	3,236	102	8,193
Pallets	Wooden	2,603	694	22	3,319
Handtools	Miscellaneous	1,368	912	29	2,309
Seeder	Broadcast seeder	16	21	1	38
Mower	7′ - 3 blade mower	205	274	9	488

Table 5a Con't

Item	Description	Depreciation**	Interest***	Insurance and Taxes****	Total
Flatbed truck	24 ft. flatbed, gas fuel	7,560	5,040	159	12,759
Heating System for Propagation					
Gas fired unit heaters - Modine	2000,000 BTU (input)	199	265	8	472
Fan jet - Acme		19	24	1	44
Thermostat	Two stage	8	11	$	19
Set-up for propane	Vent., reg., etc.	18	24	1	43
Set-up for heating system	Plywood, braces, bolts, etc.	18	24	1	43
Other Propagation Materials					
Misting system	Mist-a-matic	672	179	6	857
Pipe and nozzles	For misting system	270	72	2	344
Treated boards	5/4" x 8" x variable length	440	117	4	561
Heater cable		567	151	5	723
Subtotal		61,993	63,483	2,001	127,477
Total for Depreciation, Interest Insurance and Taxes		84,815	165,386	19,740	270,110
General Overhead					
Utilities	Telephone, electric, gas heat				9,200
Licenses and bonds					600
General repairs and maintenance	Buildings, grounds, roads				12,200
Advertising and printing					1,800
Insurance, personnel##	Workmen's comp., FICA, health, unemp.				30,400
Travel and professional fees					2,725
Administrative and management###	Clerical, operator, supervisory, labor and office supplies				104,500
Miscellaneous					2,000
Subtotal					163,425
Interest on General Overhead Insurance, and Taxes	12% per annum for 6 months on a total of $183,169				10,990
Total Annual Fixed Costs					440,525

*Two hundred acre total, 170 acres growing space, 30 acres production facilities, holding area, field bed area, roads, etc.

**Depreciation was estimated by dividing initial cost adjusted for a 10% salvage value, by the years of useful life.

***Interest costs were estimated by multiplying the initial value of land, building, equipment and machinery by the interest rate, 12% per annum.

****Insurance and taxes.

Land and improvements--Only taxes are assessed, at a rate of $20.00 per $1000.00 of market value.

Buildings--Taxes are assessed at a rate of $20.00 per $1000.00 of market value. Insurance, $500.00 deductible, at $4.46 per $1000.00 of market value. Total for category, $24.46 per $1000.00.

Machinery and equipment--Taxes are not assessed in state of Ohio on personal property. Insurance, $500.00 deductible, at $3.78 per $1000.00 of initial value.

$Less than $0.50.

##Insurance for personnel was estimated at 32% of salaries for owner/operator, supervisors, and clerical.

###Owner/operator = $35,000, 2 Supervisors @ $20,000 ea. = $40,000, 2 Clerical @ $10,000 = $20,000, Supplies 10% or $9,500. Total = $104,500.

TABLE 6. Plant Densities and losses for Field Production of Nursery Plants, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Group	Description	Size of Salable Plant	Years in Rotation	Spacing Between Rows	Spacing In Rows	Sq. Ft. Per Plant*	Plants Per Acre	Est. Percent Loss**
I	Slow Growing Evergreens - Taxus	18-24"	7	44"	28"	10.2	4,272	15
II	Fast Growing Evergreens - Juniperus	18-24"	5	44"	28"	10.2	4,272	15
III	Deciduous Shrubs - Viburnum	3-4'	4	48"	30"	11.9	3,652	15
IV	Shade Tree - Acer Rubrum	2" dia.	5	96"	42"	33.6	1,298	10
V	Ornamental Tree - Malus	5-6'(1 1/2")	4	96"	36"	28.7	1,518	10

*Sq. ft. per plant includes necessary perimeter roads.

**Assume 1/2 of loss between first and second year and remainder in last year of production. Losses in the last year of production would be left in the field.

TABLE 6a. Planting and Harvesting Requirements for a 50 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Plant Group	Description	Propagation** Units Stuck	Bedding Area*** Rooted Cuttings Planted	Field Planting Acres	Acres Planted Per Year	Units Planted Per Year	Units Harvested Per Year****
I	Slow Growing Evergreens - Taxus	7,914	6,088	8	1.14	4,870	4,140
II	Fast Growing Evergreens - Juniperus	11,107	8,544	8	1.60	6,835	5,810
III	Deciduous Shrubs - Viburnum	11,869	9,130	8	2.00	7,304	6,208
IV	Shade Tree - Acer Rubrum*****	-	-	8	1.60	2,076	1,869
V	Ornamental Tree - Malus*****	-	-	8	2.00	3,036	2,732
	Total	30,890	23,762	40	8.34	24,121	20,759

*50 total acres with 40 acres in field growing space, and 10 acres in production facilities, holding area, field bed area, roads, etc.

**For each plant available for transplanting as a rooted cutting into the bedding area, it is estimated that 1.3 cuttings would need to be stuck in the propagation facility.

***For each plant available for transplanting into the field, it is estimated that 1.25 rooted cuttings would need to be planted in the bedding area.

****Assume 1/2 dug in Fall for Fall sales and overwintering and 1/2 dug in the Spring.

*****Shade and Ornamental Trees would be purchased as bare root liners for planting directly into the field.

TABLE 6b. Planting and Harvesting Requirements for a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Plant Group	Description	Propagation** Units Stuck	Bedding Area*** Rooted Cuttings Planted	Field Planting Acres	Acres Planted Per Year	Units Planted Per Year	Units Harvested Per Year****
I	Slow Growing Evergreens - Taxus	37,710	26,700	35	5.00	21,360	18,156
II	Fast Growing Evergreens - Juniperus	48,594	37,380	35	7.00	29,904	25,418
III	Deciduous Shrubs - Viburnum	51,927	39,944	35	8.75	31,955	27,162
IV	Shade Tree - Acer Rubrum*****	-	-	35	7.00	9,086	8,177
V	Ornamental Tree - Malus*****	-	-	35	8.75	13,283	11,954
	Total	138,231	104,024	175	36.50	105,588	90,867

*200 total acres with 175 acres in field growing space, and 25 acres in production facilities, holding area, field bed area, roads, etc.

**For each plant available for transplanting as a rooted cutting into the bedding area, it is estimated that 1.3 cuttings would need to be stuck in the propagation facility.

***For each plant available for transplanting into the field, it is estimated that 1.25 rooted cuttings would need to be planted in the bedding area.

****Assume 1/2 dug in Fall for Fall sales and overwintering and 1/2 dug in the Spring.

*****Shade and Ornamental Trees would be purchased as bare root liners for planting directly into the field.

TABLE 6c. Annual Overwintering Requirements* for a 50 Acre** and 200 Acre*** Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Description	Sq. ft. Per Plant Required#	50 Acre Field Nursery			200 Acre Field Nursery		
			No. of Plants Over Wintered	Sq. Ft. of Polyhouse Required##	Sq. Ft.. of Holding Area Required	No. of Plants Over-Wintered	Sq. Ft. of Polyhouse Required##	Sq. Ft. of Holding Area Required
I	Slow Growing Evergreens - Taxus	4	1,035	4,140	--	4,539	18,156	--
II	Fast Growing Evergreens - Juniperus	4	1,453	5,812	--	6,355	25,418	--
III	Deciduous Shrubs - Viburnum	4	1,552	6,208	--	6,791	27,164	
IV	Shade Tree - Acer Rubrum	15	467	--	7,009	2,044	--	30,660
V	Ornamental Tree - Malus	15	683	--	10,245	2,989	--	44,835
TOTAL			5,190	16,160###	17,254	22,718	70,738###	75,495

*Assumed 1/4 of year's production overwintered.

**50 acres total with 40 acres of field growing space, and 10 acres of production facilities, holding area, field bed area, roads etc.

***200 acres total with 175 acres of field growing space, and 25 acres of production facilities, holding area, field bed area, roads etc.

#Sq. Ft. per plant includes necessary perimeter roads.

##One 20 x 200 sq. ft. polyhouse can hold 900 plants where each requires 4 sq. ft. The center pathway (2' x 200') would take up 400 sq. ft. of space that would not be available for plants.

###50 acre field nursery would require 4.5 polyhouses, 200 acre field nursery would require 19.7 polyhouses.

TABLE 7. Annual Shipping Requirements for a 50 Acre* and 200 Acre** Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Plant Group	Description	B & B Size	Units Per Truck	50 Acre Field Nursery: Units To Be Shipped#	50 Acre Field Nursery: No. of Truckloads	200 Acre Field Nursery: Units To Be Shipped#	200 Acre Field Nursery: No. of Truckloads
I	Evergreens - Taxus	12"	690	4,140	6.0	18,156	26.3
II	Evergreens - Juniperus	12"	690	5,810	8.4	25,418	36.8
III	Deciduous Shrubs - Viburnum	12"	690	6,208	9.0	27,162	39.4
IV	Shade Tree - Acer rubrum	24"	100	1,869	18.7	8,177	81.8
V	Ornamental Tree - Malus	18"	140	2,732	19.5	11,954	85.4
TOTAL				20,759	61.6	90,867	269.7
Trucks Req.	Fall-				15		67
	Spring-March				11		51
	-April				24.6##		100.7##
	-May				11		51

*50 acres total with 40 acres of growing space, and 10 acres of production facilities, holding area, field bed area, roads etc.

**200 acres total with 175 acres of field growing space, and 25 acres of production facilities, holding area, field bed area, roads etc.

#1/4 will be shipped in the Fall. 3/4 will be shipped in the Spring: 1/4 of the Spring shipment in March, 1/2 in April and 1/4 in May.

##Limiting factor. In the small nursery it will be necessary to ship 6+ truck loads per week and in the large 25+.

TABLE 8.--Annual Variable Costs (Dollars) for Group I Plants (Taxus) for a 50 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	9.00	58
Collecting, stripping & sticking	7914 units @ 1200/hr.	hrs.	6.93****	6.60	46
Maintainance	50% of total prop. maint. hrs	hrs	6.93	365.00	2,530
Harvest	7914 units @ 600/hr	hrs	6.93	13.19	91
Hormone powder	#8, I.B.A.	lbs.	15.50	0.23	4
Subtotal					2,729
Materials					
Burlap	32" x 32" squares + twine	each	0.45	4,140.00	1,863
Polyethylene film	4 mil white, 32' x 225'	each	127.50	1.04	133
Strip tags	5/8" X 7" plastic strip tag	each	0.02	4,140.00	83
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	0.72	127
	Custom spread, (lime)	ton	20.00	1.28	26
	Urea, 45-0-0 (fertilizer)	ton	220.00	1.38	304
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.14	198
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	0.32	11
	Simazine 80WP (Princep) (herbicide)	pound	3.75	17.45	65
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	50.69	323
	Malathion, 57EL (Cythion) (insecticide)	gallon	18.28	16.34	299
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	10.89	154
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	27.23	166
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	3.12	5
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				310
Subtotal					4,067
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	32.54	553
	Tractor, 34 HP	hour	4.99	32.31	161
	Articulated Loader/3,000lbs	hour	14.81	26.98	400
	Forks	hour	0.01	73.24	1
	Plow, 3-14"	hour	6.57	1.02	7
	Disk, 8' wide	hour	4.23	2.09	9
	Harrow, 10' wide	hour	8.45	0.16	1
	Cultimulcher, 10' wide	hour	24.70	0.31	8
	Spray rig with 10' boom	hour	2.77	2.76	8
	Transplanter, 3 row	hour	26.79	1.23	33
	Permanent irrigation\ well & pump 100HP	hour	7.60	86.28	656
	Inground irrigation - bed/field area	hour	3.13	72.00	225
	Above ground irrigation - bed area	hour	1.83	72.00	132
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Traveler gun	hour	12.06	2.28	28

Table 8 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Portable PTO pump, 40 HP (Emergency)	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	21.78	22
	Fertilizer injector	hour	12.39	4.50	56
	Transplanter, 2 row	hour	12.00	2.03	24
	Undercutter, bed	hour	1.16	1.17	1
	U-Blade	hour	17.56	0.38	7
	Sidedresser, 2 row	hour	0.63	7.53	5
	Cultivator, 2 row	hour	.95	12.56	12
	Wagon, 4 wheel	hour	0.48	10.80	5
	Cultivator, 3 row	hour	13.93	1.38	19
	Truck, 1/2 ton pickup	hour	8.42	346.67	2,919
	Flatbed truck, 24' bed	hour	14.87	26.98	401
Subtotal					5,894
Labor					
	Labor hours	hour	6.93****	1,369.51	9,491
	Related labor hours, 20%	hour	6.93	273.90	1,898
Subtotal					11,389
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	24,079.00	1,445
Total Annual Variable Costs					25,524
Variable Cost per 18-24 Inch Salable Plant	Units available for sale in a given year	each		4,140.00	6.17

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc. Group I Plants - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc., 4,140, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***7,914 plants would be stuck in the propagation house annually where about 23% would be lost over a two year period leaving 6,088 for transplanting into liner beds. About 20% of the plants in the liner beds would be lost over a three year period leaving 4,870 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 8a.--Annual Variable Costs (Dollars) for Group I Plants (Taxus) for a 200 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	18.00	117
Collecting, stripping & sticking	37,710 units @ 1200/hr.	hrs.	6.93****	31.43	218
Maintainance	50% of total prop. maint. hrs.	hrs.	6.93	400.00	2,772
Harvest	37,710 units @ 600/hr.	hrs.	6.93	62.85	436
Hormone powder	#8, I.B.A.	lbs.	15.50	1.08	17
Subtotal					3,560
Materials					
Burlap	32" x 32" squares + twine	each	0.45	18,156.00	8,170
Polyethylene film	4 mil white, 32' x 225'	each	127.50	4.54	579
Strip tags	5/8" X 7" plastic strip tag	each	0.02	18,156.00	363
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	3.17	558
	Custom spread, (lime)	ton	20.00	5.16	103
	Urea, 45-0-0 (fertilizer)	ton	220.00	5.50	1,210
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.55	776
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	1.40	47
	Simazine 80WP (Princep) (herbicide)	pound	3.75	79.58	298
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	208.89	1,331
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	71.61	1,309
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	24.75	351
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	119.36	727
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	13.36	24
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				1,194
Subtotal					17,070
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	18.73	318
	Tractor, 60 HP	hour	11.68	23.77	278
	Tractor, 34 HP	hour	4.99	141.56	706
	Articulated Loader/2,000lbs	hour	6.67	82.25	549
	Articulated Loader/3,000lbs	hour	14.81	82.25	1,218
	Forks	hour	0.01	164.50	2
	Plow, 3-14"	hour	6.57	4.49	29
	Disk, 8' wide	hour	4.23	9.09	38
	Harrow, 10' wide	hour	8.45	0.67	6
	Cultimulcher, 10' wide	hour	24.70	1.34	33
	Spray rig with 10' boom	hour	2.77	12.01	33
	Transplanter, 3 row	hour	26.79	5.34	143
	Permanent irrigation\ well & pump 100HP	hour	7.60	118.00	897
	Inground irrigation - bed/field area	hour	3.13	96.00	300
	Above ground irrigation - bed area	hour	1.83	96.00	176
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Travler gun	hour	12.06	10.00	121

Table 8a Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Portable PTO pump, 40 HP (emergency)	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	95.49	96
	Fertilizer injector	hour	12.39	4.5	56
	Transplanter, 2 row	hour	12.00	8.90	107
	Undercutter, bed	hour	1.16	5.13	6
	U Blade	hour	17.56	1.65	29
	Sidedresser, 2 row	hour	0.63	33.00	21
	Cultivator, 2 row	hour	.95	59.4	56
	Wagon, 4 wheel	hour	0.48	47.30	23
	Cultivator, 3 row	hour	13.93	6.03	84
	Truck, 1/2 ton pickup	hour	8.42	520.00	4,378
	Flatbed truck, 24' bed	hour	14.87	123.38	1,835
Subtotal					11,739
Labor					
	Labor hours	hour	6.93****	5,356.02	37,117
	Related labor hours, 20%	hour	6.93	1,071.20	7,423
Subtotal					44,540
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	76,909.00	4,615
Total Annual Variable Costs					81,524
Variable Cost per 18-24 Inch Salable Plant	Units available for sale in a given year	each		18,156.00	4.49

*Total Nursery - 200 acres; 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc., Group I Plants - 40 acres; 34 acres of growing space, 6 acres production facilities, holding & field bed area, roads, etc., 18,156, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***34,710 plants would be stuck in the propagation house where about 23% would be lost leaving 26,700 for transplanting into liner beds. About 20% of the plants in the liner beds would be lost leaving 21,360 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 9.--Annual Variable Costs (Dollars) for Group II Plants (Juniperus) for a 50 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	12.00	78
Collecting, stripping & sticking	11,107 @ 700/hr.	hrs.	6.93****	6.60	46
Maintainance	25% of total prop. maint. hrs.	hrs.	6.93	182.50	1,265
Harvest	11,107 @ 500/hr.	hrs.	6.93	22.21	154
Hormone powder	#3, I.B.A.	lbs.	11.70	0.32	4
Subtotal					1,611
Materials					
Field pot	32" x 32" squares + twine	each	0.45	5,810.00	2,615
Polyethylene film	4 mil white, 32' x 225'	each	127.50	1.45	185
Strip tags	5/8" X 7" plastic strip tag	each	0.02	5,810.00	116
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	1.02	180
	Custom spread, (lime)	ton	20.00	1.80	36
	Urea, 45-0-0 (fertilizer)	ton	220.00	0.88	194
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.12	169
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	0.45	15
	Simazine 80WP (Princep) (herbicide)	pound	3.75	13.00	49
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	36.40	232
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	11.70	214
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	19.50	276
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	7.80	48
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	4.55	8
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				
Subtotal					4,337
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	24.29	413
	Tractor, 34 HP	hour	4.99	37.31	186
	Articulated Loader/3,000 lbs.	hour	14.81	49.77	737
	Fork	hour	0.01	49.77	1
	Plow, 3-14"	hour	6.57	1.44	9
	Disk, 8' wide	hour	4.23	3.48	15
	Harrow, 10' wide	hour	8.45	0.21	2
	Cultimulcher, 10' wide	hour	24.74	0.38	10
	Spray rig with 10' boom	hour	2.77	2.14	6
	Transplanter, 3 row	hour	26.79	1.71	46
	Permanent irrigation\ well & pump 100HP	hour	7.60	63.20	480
	Inground irrigation - bed area	hour	3.13	48.00	150
	Above ground irrigation - bed area	hour	1.83	48.00	88
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Traveler gun	hour	12.06	3.20	39

Table 9 Cont.

Item	Description	Unit	Unit**	Quantity	Cost
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	15.60	16
	Fertilizer injector	hour	12.39	3.00	37
	Transplanter, 2 row	hour	12.0	2.84	34
	Undercutter, bed	hour	1.16	1.64	2
	Sidedresser, 2 row	hour	0.63	4.80	3
	Cultivator, 2 row	hour	.95	9.51	9
	Wagon, 4 wheel	hour	0.48	15.12	7
	Cultivator, 3 row	hour	13.93	1.32	18
	Truck, 1/2 ton pickup	hour	8.42	346.67	2,919
	Flatbed truck, 24' bed	hour	14.87	36.47	542
Subtotal					5,970
Labor					
	Labor hours	hour	6.93****	1,491.56	10,337
	Related labor hours, 20%	hour	6.93	298.00	2,065
Subtotal					12,402
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	24,320.00	1,459
Total Annual Variable Costs					25,779
Variable Cost per 18-24 Inch Salable Plant	Units available for sale in a given year	each		5,810.00	4.44

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc. Group II Plants - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc., 5,810, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***11,107 plants would be stuck in the propagation house where about 23% would be lost leaving 8,544 for transplanting into liner beds. About 20% of the plants in the liner beds would be lost leaving 6,835 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 9a.--Annual Variable Costs (Dollars) for Group II Plants (Juniperus) for a 200 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yds.	6.50	24.00	156
Collecting, stripping & sticking	48,594 @ 700/hr.	hrs.	6.93****	69.42	481
Maintainance	25% of total prop. maint. hrs.	hrs.	6.93	175.00	1,213
Harvest	48,594 @ 500/hr.	hrs.	6.93	97.19	674
Hormone powder	#3, I.B.A.	lbs.	11.70	1.39	16
Subtotal					2,540
Materials					
Burlap	32" x 32" squares + twine	each	0.45	25,418.00	11,438
Polyethylene film	4 mil white, 32' x 225'	each	127.50	6.35	810
Strip tags	5/8" X 7" plastic strip tag	each	0.02	25,418.00	508
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	4.44	781
	Custom spread, (lime)	ton	20.00	4.95	99
	Urea, 45-0-0 (fertilizer)	ton	220.00	4.95	1,089
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.52	734
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	1.97	66
	Simazine 80WP (Princep) (herbicide)	pound	3.75	61.10	229
	DCPA 75WP (Decthal) (herbicide)	pound	6.37	159.04	1,013
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	48.59	888
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	32.36	459
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	80.90	493
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	19.05	34
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				920
Subtotal					19,561
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	26.23	446
	Tractor, 60 HP	hour	11.68	79.25	926
	Tractor, 34 HP	hour	4.99	142.18	709
	Articulated Loader/2,000lbs	hour	6.67	49.88	333
	Articulated Loader/3,000lbs	hour	14.81	49.88	739
	Forks	hour	0.01	99.67	1
	Plow, 3-14"	hour	6.57	6.29	41
	Disk, 8' wide	hour	4.23	10.84	46
	Harrow, 10' wide	hour	8.45	0.94	8
	Cultimulcher, 10' wide	hour	24.70	1.65	41
	Spray rig with 10' boom	hour	2.77	9.37	26
	Transplanter, 3 row	hour	26.79	7.48	200
	Permanent irrigation\ well & pump 100HP	hour	7.60	88.00	669
	Inground irrigation - bed area	hour	3.13	62.00	194
	Above ground irrigation - bed area	hour	1.83	62.00	113
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Traveler gun	hour	12.06	14.00	169

Table 9a Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	68.16	69
	Fertilizer injector	hour	12.39	3.00	37
	Transplanter, 2 row	hour	12.00	12.46	150
	Undercutter, bed	hour	1.16	7.19	8
	Sidedresser, 2 row	hour	0.63	21.00	13
	Cultivator, 2 row	hour	.95	41.58	40
	Wagon, 4 wheel	hour	0.48	66.20	32
	Cultivator, 3 row	hour	13.93	5.68	79
	Truck, 1/2 ton pickup	hour	8.42	520.00	4,378
	Flatbed truck, 24' bed	hour	14.87	159.48	2,371
Subtotal					12,039
Labor					
	Labor hours	hour	6.93****	6,271.93	43,465
	Related labor hours, 20%	hour	6.93	1,254.38	8,693
Subtotal					52,158
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	86,298.00	5,178
Total Annual Variable Costs					91,476
Variable Cost per 18-24 Inch Salable Plant	Units available for sale in a given year	each		25,418	3.60

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc. Group II Plants - 40 acres, 34 acres of growing space, 6 acres production facilities, holding & field bed area, roads, etc., 25,418, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***48,594 plants would be stuck in the propagation house where about 23% would be lost leaving 37,380 for transplanting into liner beds. About 20% of the plants in liner beds would be lost leaving 29,904 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 10.--Annual Variable Costs (Dollars) for Group III Plants (Viburnum) for a 50 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	12.00	78
Collecting, stripping & sticking	11,869 @ 1000/hr.	hrs.	6.93	11.87	82
Maintainance	25% of total prop. maint, hrs.	hrs.	6.93	182.50	1,265
Harvest	11,869 @ 400/hr.	hrs.	6.93	29.68	206
Hormone powder	#1, I.B.A.	lbs.	8.00	0.34	3
Subtotal					1,634
Materials					
Burlap	32" x32" squares + twine	each	0.45	6,208.00	2,794
Polyethylene film	4 mil white, 32' x 225'	each	127.50	1.55	198
Strip tags	5/8" X 7" plastic strip tag	each	0.02	6,208.00	124
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	1.25	220
	Custom spread, (lime)	ton	20.00	1.21	24
	Urea, 45-0-0 (fertilizer)	ton	220.00	0.66	145
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.06	85
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	0.55	18
	Simazine 80WP (Princep) (herbicide)	pound	3.75	15.53	58
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	43.47	277
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	13.97	255
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	9.32	132
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	23.29	142
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	4.65	8
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				265
Subtotal					4,745
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	35.58	605
	Tractor, 34 HP	hour	4.99	34.44	172
	Articulated Loader/3,000lbs	hour	14.81	57.78	856
	Fork	hour	0.01	57.78	1
	Plow, 3-14"	hour	6.57	1.77	12
	Disk, 8' wide	hour	4.23	3.58	15
	Harrow, 10' wide	hour	8.45	0.27	2
	Cultimulcher, 10' wide	hour	24.70	0.54	13
	Spray rig with 10' boom	hour	2.77	2.57	7
	Transplanter, 3 row	hour	26.79	1.83	49
	Permanent irrigation\ well & pump 100HP	hour	7.60	40.00	304
	Inground irrigation - bed area	hour	3.13	24.00	75
	Above ground irrigation - bed area	hour	1.83	24.00	44
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Traveler gun	hour	12.06	4.00	48

Table 10 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	18.63	19
	Fertilizer injector	hour	12.39	1.50	19
	Transplanter, 2 row	hour	12.00	3.04	36
	Undercutter, bed	hour	1.61	1.76	3
	Sidedresser, 2 row	hour	0.63	3.60	2
	Cultivator, 2 row	hour	.95	11.88	11
	Wagon, 4 wheel	hour	0.48	16.16	8
	Cultivator, 3 row	hour	13.93	0.69	10
	Truck, 1/2 ton pickup	hour	8.42	346.71	2,919
	Flatbed truck, 24' bed	hour	14.87	35.92	534
Subtotal					5,965
Labor					
	Labor hours	hour	6.93****	1,651.59	11,446
	Related labor hours, 20%	hour	6.93	330.32	2,289
Subtotal					13,735
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	26,079.00	1,565
Total Annual Variable Costs					27,644
Variable Cost per 18-24 Inch Salable Plant	Units available for sale in a given year	each		6,208.00	4.45

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc. Group III Plants - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc., 6,208, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***11,869 plants would be stuck in the propagation house where about 23% would be lost leaving 9,130 for transplanting into liner beds. About 20% of the plants in the liner beds would be lost leaving 7,304 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 10a.--Annual Variable Costs (Dollars) for Group III Plants (Viburnum) for a 200 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	24	156
Collecting, stripping & sticking	51,927 @ 1000/hr	hrs.	6.93	51.93	360
Maintainance	25% of total prop. maint. hrs.	hrs.	6.93	175.00	1,213
Harvest	51,927 @ 400/hr.	hrs.	6.93	129.93	900
Hormone powder	#1, I.B.A.	lbs.	8.00	1.49	12
Subtotal					2,641
Materials					
Burlap	32" x 32" + squares + twine	each	0.45	27,162.00	12,223
Polyethylene film	4 mil white, 32' x 225'	each	127.50	6.79	866
Strip tags	5/8" X 7" plastic strip tag	each	0.02	27,162.00	543
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	5.46	961
	Custom spread, (lime)	ton	20.00	9.67	193
	Urea, 45-0-0 (fertilizer)	ton	220.00	2.89	636
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.28	395
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	2.42	81
	Simazine 80WP (Princep) (herbicide)	pound	3.75	67.93	255
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	190.19	1,212
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	61.13	1,117
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	40.76	578
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	101.89	621
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	20.37	36
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				1,158
Subtotal					20,875
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	29.04	494
	Tractor, 60 HP	hour	11.68	125.56	1,467
	Tractor, 34 HP	hour	4.99	156.04	779
	Articulated Loader/2,000lbs	hour	6.67	126.42	843
	Articulated Loader/3,000lbs	hour	14.81	126.42	1,872
	Forks	hour	0.01	252.83	3
	Plow, 3-14"	hour	6.57	7.74	51
	Disk, 8' wide	hour	4.23	15.67	66
	Harrow, 10' wide	hour	8.45	1.16	10
	Cultimulcher, 10' wide	hour	24.70	2.28	56
	Spray rig with 10' boom	hour	2.77	11.28	31
	Transplanter, 3 row	hour	26.79	7.99	214
	Permanent irrigation\ well & pump 100HP	hour	7.60	61.50	467
	Inground irrigation - bed area	hour	3.13	32.00	100
	Above ground irrigation - bed area	hour	1.83	32.00	59
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Traveler gun	hour	12.06	17.50	211

Table 10a Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	78.75	80
	Fertilizer injector	hour	12.39	1.50	19
	Transplanter, 2 row	hour	12.00	13.31	160
	Undercutter, bed	hour	1.16	7.68	9
	Sidedresser, 2 row	hour	0.63	15.75	10
	Cultivator, 2 row	hour	.95	34.66	33
	Wagon, 4 wheel	hour	0.48	70.76	34
	Cultivator, 3 row	hour	13.93	3.04	42
	Truck, 1/2 ton pickup	hour	8.42	533.31	4,490
	Flatbed truck, 24' bed	hour	14.87	157.14	2,337
Subtotal					14,138
Labor					
	Labor hours	hour	6.93 ****	7,165.73	49,658
	Related labor hours, 20%	hour	6.93	1,433.15	9,932
Subtotal					59,590
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	97,244.00	5,835
Total Annual Variable Costs					103,079
Variable Cost per 18-24 Inch Salable Plant	Units available for sale in a given year	each		27,162.00	3.80

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc. Group III Plants - 40 acres, 34 acres of growing space, 6 acres production facilities, holding & field bed area, roads, etc., 27,162, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***51,927 plants would be stuck in the propagation house where about 23% would be lost leaving 39,944 for transplanting into liner beds. About 20% of the plants in liner beds would be lost leaving 31,955 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 11.--Annual Variable Costs (Dollars) for Group IV Plants (Acer rubrum) for a 50 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones five and six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Materials					
Burlap	54" x 54" squares + 24" basket	each	3.10	1,869.00	5,794
Twine	Nails + twine	each	0.15	1,869.00	280
Liners	6-8' 2 yr branched	each	11.09	2,076.00	23,023
Strip tags	5/8" X 7" plastic strip tag	each	0.02	1,869.00	37
Poultry wire	1" for rabbit control	roll	29.00	2.00	58
Seed	Rye Grass (Kentucky 31)	pound	0.64	348.48	223
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	0.90	158
	Custom spread, (lime)	ton	20.00	1.60	32
	Urea, 45-0-0 (fertilizer)	ton	220.00	0.70	154
	Trifluralin 4 EC (Treflan) (herbivide)	gallon	33.49	0.40	13
	Simazine 80WP (Princep) (herbicide)	pound	3.75	16.00	60
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	47.04	300
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	14.40	263
	Benomyl, 50WP, (Benlate) (fungicide)	pound	14.17	9.60	136
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	24.00	146
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)****				272
Subtotal					30,949
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	49.84	847
	Tractor, 34 HP	hour	4.99	22.86	114
	Flatbed truck, 24' bed	hour	14.87	125.76	1,870
	Articulated Loader/3,000lbs	hour	14.81	54.89	813
	Tree spade	hour	5.30	125.79	667
	Forks	hour	0.01	54.89	1
	Plow, 3-14"	hour	6.57	1.28	8
	Disk, 8' wide	hour	4.23	2.28	10
	Harrow, 10' wide	hour	8.45	0.19	2
	Cultimulcher, 10' wide	hour	24.70	0.34	8
	Spray rig with 10' boom	hour	2.77	2.50	7
	Transplanter, one row (tree)	hour	0.92	37.75	35
	Permanent irrigation/well & pump 100Hp	hour	7.60	15.20	116
	Inground irrigation - storage & holding	hour	5.56	12.00	67
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Inground irrigation - bed/field	hour	3.13	3.20	10
	Traveler gun	hour	12.06	3.20	39
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	19.20	19
	Mower	hour	2.98	4.36	13
	Seeder	hour	1.05	2.16	2
	Sidedresser, 2 row	hour	0.63	3.84	2
	Cultivator, 2 row	hour	.95	4.24	4
	Wagon, 4 wheel	hour	0.48	6.10	3
	Truck, 1/2 ton pickup	hour	8.42	384.42	3,237
	Flatbed truck, 24' bed	hour	14.87	125.76	1,870
Subtotal					9,897

Table 11 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Labor					
	Labor hours	hour	6.93***	1,340.44	9,290
	Related labor hours, 20%	hour	6.93	268.00	1,858
Subtotal					11,148
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	51,994.00	3,120
Total Annual Variable Costs					55,114
Variable Cost per Salable Plant (2" caliper)	Units available for sale in a given year	each		1,869.00	29.49

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc. Group IV Plants - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc., 1,869, 2 inch caliper salable plants per year.

**Quantity discounts were applited to chemicals and other items.

***Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 11a.--Annual Variable Costs (Dollars) for Group IV Plants (Acer rubrum) for a 200 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Materials					
Burlap	54' x 54" squares - 24" basket	each	3.10	8,177.00	25,349
Twine	Nails + twine	each	0.15	8,177.00	1,227
Liners	6-8' 2 yr branched	each	8.68	9,086.00	78,866
Strip tags	5/8" X 7" plastic strip tag	each	0.02	8,177.00	164
Poultry wire	1" poultry wire for rabbit control	roll	29.00	9.00	261
Seed	Rye grass (Kentucky 31)	pound	0.64	1,524.60	976
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	3.95	695
	Custom spread, (lime)	ton	20.00	7.00	140
	Urea, 45-0-0 (fertilizer)	ton	220.00	3.08	678
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	1.75	59
	Simazine 80WP (Princep) (herbicide)	pound	3.75	70.00	263
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	196.00	1,249
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	63.00	1,152
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	42.00	595
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	105.00	639
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)****				1,193
Subtotal					113,506
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	170.82	2,904
	Tractor, 60 HP	hour	11.68	102.20	1,194
	Tractor, 34 HP	hour	4.99	88.85	443
	Articulated Loader/2,000lbs	hour	6.67	108.75	725
	Articulated Loader/3,000lbs	hour	14.81	108.75	1,611
	Tree spade	hour	5.30	543.07	2,878
	Forks	hour	0.01	217.49	2
	Plow, 3-14"	hour	6.57	5.60	37
	Disk, 8' wide	hour	4.23	9.45	40
	Harrow, 10' wide	hour	8.45	0.84	7
	Cultimulcher, 10' wide	hour	24.70	1.47	36
	Spray rig with 10' boom	hour	2.77	10.99	30
	Transplanter, one row (tree)	hour	0.92	165.20	152
	Permanent irrigation\ well & pump 100HP	hour	7.60	26.00	198
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Inground irrigation - bed/field	hour	3.13	14.00	44
	Traveler gun	hour	12.06	14.00	169
	Portable PTO pump, 40 HP	hour	3.75	3.40	13
	Airblast sprayer	hour	1.01	84.00	85
	Seeder	hour	1.05	4.76	5
	Mower	hour	2.98	19.04	57
	Sidedresser, 2 row	hour	0.63	16.80	11
	Cultivator, 2 row	hour	.95	18.48	18
	Wagon, 4 wheel	hour	0.48	26.20	13
	Truck, 1/2 ton pickup	hour	8.42	685.20	5,769
	Flatbed truck, 24' bed	hour	14.87	545.07	8,105
Subtotal					24,747

Table 11a Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Labor					
	Labor hours	hour	6.93 ***	6,320.04	43,789
	Related labor hours, 20%	hour	6.93	1,264.00	8,760
Subtotal					52,558
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	190,811.00	11,449
Total Annual Variable Costs					202,260
Variable Cost per Salable Plant (2" caliper)	Units available for sale in a given year	each		8,177.00	24.74

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc. Group IV Plants - 40 acres, 34 acres of growing space, 6 acres production facilities, holding & field bed area, roads, etc., 8,177, 2 inch caliper salable plants per year.

**Quanltity discounts were applied to chemicals and other items.

***Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 12.--Annual Variable Costs (Dollars) for Group V Plants (Malus) for a 50 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Materials					
Burlap	54" x 54" squares + 18" basket	each	2.53	2,732.00	6,912
Twine	Nails + twine	each	0.15	2,732.00	410
Liners	5'-6' 2 yr. branched	each	6.00	3,036.00	18,216
Strip tags	5/8" X 7" plastic strip tag	each	0.02	2,732.00	55
Poultry wire	1" poultry wire for rabbit control	roll	29.00	2.00	58
Seed	Rye grass (Kentucky 31)	pound	0.64	435.60	279
Chemicals	Custom spread, custom blend: 45-0-0				
	0-44-0, 0-0-60 (fertilizer)	ton	176.00	1.13	199
	Custom spread, (lime)	ton	20.00	2.00	40
	Urea, 45-0-0 (fertilizer)	ton	220.00	0.66	145
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	0.50	17
	Simazine 80WP (Princep) (herbicide)	pound	3.75	15.00	56
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	44.10	281
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	13.50	247
	Benomyl, 50WP, (Benlate) (fungicide)	pound	14.17	9.50	135
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	22.50	137
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)****				260
Subtotal					27,447
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	68.48	1,164
	Tractor, 60 HP	hour	11.68	17.06	199
	Tractor, 34 HP	hour	4.99	41.78	208
	Articulated Loader/3,000lbs	hour	14.81	92.10	1,364
	Tree spade	hour	5.30	102.57	544
	Forks	hour	0.01	92.10	1
	Plow, 3-14"	hour	6.57	1.60	11
	Disk, 8' wide	hour	4.23	3.24	14
	Harrow, 10' wide	hour	8.45	0.24	2
	Cultimulcher, 10' wide	hour	27.44	0.42	12
	Spray rig with 10' boom	hour	2.77	2.46	7
	Transplanter, one row (tree)	hour	0.92	55.20	51
	Permanent irrigation\ well & pump 100HP	hour	7.60	16.00	122
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Inground irrigation - bed/field	hour	3.13	4.00	13
	Traveler gun	hour	12.06	4.00	48
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	18.00	18
	Seeder	hour	1.05	1.02	1
	Mower	hour	2.98	4.08	12
	Sidedresser, 2 row	hour	0.63	3.60	2
	Cultivator, 2 row	hour	0.95	3.96	4
	Wagon, 4 wheel	hour	0.48	8.16	4
	Truck, 1/2 ton pickup	hour	8.42	346.67	2,919
	Flatbed truck, 24' bed	hour	14.87	157.77	2,346
Subtotal					9,267

Table 12 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Labor					
	Labor hours	hour	6.93 ***	1,674.91	11,607
	Related labor hours, 20%	hour	6.93	335.00	3,357
Subtotal					14,964
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	51,678.00	3,101
Total Annual Variable Costs					54,779
Variable Cost per Salable Plant (1 1/2" caliper)	Units available for sale in a given year	each		2,732.00	20.05

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc. Group V Plants - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc., 2,732, 2 inch caliper salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 12a.--Annual Variable Costs (Dollars) for Group V Plants (Malus) for a 200 Acre* Field Nursery, U.S.D.A Plant Hardiness Zones Five and Six, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Materials					
Burlap	54" x 54" squares + 18" baskets	each	2.53	11,954.00	30,244
Twine	Nails + twine	each	.15	11,954.00	1,793
Liners	5-6' 2 yr branched	each	4.86	13,283.00	64,555
Strip tags	5/8" X 7" plastic strip tag	each	0.02	11,954.00	239
Poultry wire	1" for rabbit control	roll	29.00	9.00	261
Seed	Rye grass (Kentucky 31)	pound	0.64	1,905.75	1,220
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	4.94	869
	Custom spread, (lime)	ton	20.00	8.75	175
	Urea, 45-0-0 (fertilizer)	ton	220.00	3.85	847
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	8.75	293
	Simazine 80WP (Princep) (herbicide)	pound	3.75	87.50	328
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	245.00	1,561
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	78.75	1,440
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	131.25	1,860
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	52.50	320
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)****				1,810
Subtotal					107,815
Machinery and Equipment					
	Tractor, 75 HP	hour	17.00	248.51	4,225
	Tractor, 60 HP	hour	11.68	252.38	2,948
	Tractor, 34 HP	hour	4.99	102.65	512
	Articulated loader/2,000lbs	hour	6.67	157.26	1,049
	Articulated loader/3,000lbs	hour	14.87	157.26	2,338
	Tree spade	hour	5.30	475.16	2,518
	Forks	hour	0.01	314.52	3
	Plow, 3-14"	hour	6.57	7.00	46
	Disk, 8' wide	hour	4.23	14.18	60
	Harrow, 10' wide	hour	8.45	1.05	9
	Cultimulcher, 10' wide	hour	27.44	1.84	50
	Spray rig with 10' boom	hour	2.77	13.76	38
	Transplanter, one row (tree)	hour	0.92	241.51	222
	Permanent irrigation\ well & pump 100HP	hour	7.60	29.50	224
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Inground irrigation - bed/field	hour	3.13	17.50	55
	Traveler gun	hour	12.06	17.50	211
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	78.75	80
	Seeder	hour	1.05	5.96	6
	Mower	hour	2.98	23.80	71
	Sidedresser, 2 row	hour	0.63	15.70	10
	Cultivator, 2 row	hour	0.95	17.34	16
	Wagon, 4 wheel	hour	0.48	38.34	18
	Truck, 1/2 ton pickup	hour	8.42	520.00	4,378
	Flatbed truck, 24' bed	hour	14.87	716.67	10,657
Subtotal					29,945

Table 12a Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Labor					
	Labor hours	hour	6.93 ***	6,881.83	47,691
	Related labor hours, 20%	hour	6.93	1,376.00	9,537
Subtotal					57,228
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	194,988.00	11,699
Total Annual Variable Costs					206,687
Variable Cost per Salable Plant (1 1/2" caliper)	Units available for sale in a given year	each		11,954.00	17.29

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc. Group V Plants - 40 acres, 34 acres of growing space, 6 acres production facilities, holding & field bed area, roads, etc., 11,954, 5-6' (1 1/2") salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

****To achieve better pest and disease control alternating chemical applications are advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 13.--Estimated Variable Cost per Hour of Use for Machinery and Equipment for Field Nurseries, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item Number	Item	New Cost (dollars)	Expected Life (years)	Estimated Annual Use: 50 Acre* Nursery (hours)	Estimated Annual Use: 200 Acre** Nursery (hours)	Estimated Cost per Hour of Use: Repairs*** (dollars)	Fuel**** (dollars)	Lubrication and Filter (dollars)	Total (dollars)
1	Tractor, 75 HP	28,278	10	217	494	5.15	10.30	1.55	17.00
2	Tractor, 60 HP	20,419	10	--	583 ea	3.15	7.42	1.11	11.68
3	Tractor, 34 HP	14,504	10	169	632	2.07	2.54	0.38	4.99
4	Flatbed truck	42,000	10	383	1,702	2.22	11.00	1.65	14.87
5	Articulated Loader/2,000lbs	25,000	10	--	600	3.75	2.54	0.38	6.67
6	Articulated Loader/3,000lbs	38,000	10	328	600	5.70	7.92	1.19	14.81
7	Tree Spade	8,490	2	181	641	5.30			5.30
8	Forks for loaders	1,100	10	328	1,200	0.01			0.01
9	Plow	2,616	10	8	32	6.57			6.57
10	Disk	3,900	10	15	60	4.23			4.23
11	Harrow	650	10	2	5	8.45			8.45
12	Cultimulcher	3,800	10	3	10	24.70			24.70
13	Spray rig (Boom Sprayer)	1,407	7	13	58	2.77			2.77
14	Transplanter, 3 row	7,500	10	5	21	26.79			26.79
15	Transplanter, one row	5,000	10	93	407	0.92			0.92
16	Permanent irrigation, well+pump	36,396	20	221	323	0.56	6.12	0.92	7.60
17	Inground irr. bed-field*****	34,606	20	151	221	3.13			3.13
18	Above ground irr. bed-field*****	4,345	5	144	190	1.83			1.83
19	Inground irr. storage/hold*****	16,957	20	60	60	5.65			5.65
20	Above ground irr. S. & H.*****	8,286	5	60	60	11.05			11.05
21	Traveler*****	22,000	10	17	73	12.06			12.06
22	Portable irr. pump (emergency)	425	10	--	--	--	--	--	--
23	Airblast sprayer	3,600	7	94	406	1.01			1.01
24	Fertilizer injector	858	5	9 ea	9 ea	12.39			12.39
25	Transplanter, 2 row	5,600	10	8	35	12.00			12.00
26	Undercutter - bed	285	7	5	21	1.16			1.16
27	U-Blade - field	240	5	0.38	1.65	17.65			17.65
28	Fertilizer sidedresser	1,000	10	24	103	0.63			0.63
29	Cultivator, 2 row	1,750	7	44	172	0.95			0.95
30	Wagon	1,978	10	57 ea	249 ea	0.48			0.48
31	Cultivator, 3 row	2,250	7	4	15	13.93			13.93
32	Truck - 1/2 ton pickup	13,485	5	1,771	2,779	4.37	3.52	0.53	8.42
33	Mower	2,283	10	9	46	2.98			2.98
34	Seeder	175	10	4	10	1.05			1.05

*50 total acres

**200 total acres

***Repairs per hour were based on useage of the large nursery. They were computed on the basis of percent of new cost over the life of the asset. Percent factors used were: 90 for item numbers 1, 2, 3, 4, 5, 6, 32; 80 for items 9, 13, 23; 75 for items 14, 15, 25, 28; 65 for items 10, 11, 12, 24, 29, 31; 60 for items 26, 27, 30, 33, 34; 40 for items 7, 17, 18, 19, 20, 21, 22; and 10 for items 8, 16. The total was then divided by the estimated total number of hours the equipment would be asset.

****Fuel was estimated at $ 1.10 gallon for gasoline drived items, $1.03 for diesel drived items and $0.31 per killowatt for electrical driven.

*****Cost is for a large nursery on which variable costs per hour were based. Cost for the small nursery was lower.

TABLE 14.--Summary of Annual Fixed, Variable and Total Costs (Dollars) of Operating a 50 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Group I (Taxus)	Group II (Juniper)	Group III (Viburnum)	Group IV (Acer rubrum)	Group V (Malus)	Total
Fixed Cost						
Land and improvements	7,061	7,061	7,061	7,061	7,061	35,304**
Buildings	4,740	4,740	4,740	4,740	4,740	23,698**
Machinery and equipment	13,173	13,173	13,173	13,173	13,173	65,866**
General overhead	20,592	20,592	20,592	20,592	20,592	102,960**
Interest on general overhead, insurance, and taxes	1,336	1,336	1,336	1,336	1,336	6,678**
Subtotal	46,902	46,902	46,902	46,902	46,902	234,506**
Variable Costs						
Propagation	2,729	1,611	1,634	***	***	5,974
Materials	4,067	4,337	4,745	30,949	27,447	71,545
Machinery and equipment	5,894	5,970	5,965	9,897	9,267	36,993
Labor	11,389	12,402	13,735	11,148	14,964	63,638
Interest on operating capital	1,445	1,459	1,565	3,120	3,101	10,690
Subtotal	25,524	25,779	27,644	55,114	54,779	188,840
TOTAL	72,426	72,681	74,546	102,016	101,681	423,346**
Salable Plants per Year	4,140	5,810	6,208	1,869	2,732	20,759
Annual Cost per Salable Plant	17.49	12.51	12.00	54.58	37.22	20.40

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc.
**Individual figures do not always add to the total due to rounding.
***Tree liners were purchased rather than propagated. Liner costs were included under materials.

TABLE 14a.--Summary of Annual Fixed, Variable and Total Costs (Dollars) of Operating a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Group I (Taxus)	Group II (Juniper)	Group III (Viburnum)	Group IV (Acer rubrum)	Group V (Malus)	Total
Fixed Cost						
Land and improvements	21,716	21,716	21,716	21,716	21,716	108,578**
Buildings	6,811	6,811	6,811	6,811	6,811	34,055**
Machinery and equipment	25,495	25,495	25,495	25,495	25,495	127,477**
General overhead	32,685	32,685	32,685	32,685	32,685	163,425**
Interest on general overhead, isurance, and taxes	2,198	2,198	2,198	2,198	2,198	10,990**
Subtotal	88,903	88,903	88,903	88,903	88,903	444,525**
Variable Costs						
Propagation	3,560	2,540	2,641	***	***	8,741
Materials	17,070	19,561	20,875	113,506	107,815	278,827
Machinery and equipment	11,739	12,039	14,138	24,747	29,945	92,608
Labor	44,540	52,158	59,590	52,558	57,228	266,074
Interest on operating capital	4,615	5,178	5,835	11,449	11,699	38,776
Subtotal	81,524	91,476	103,079	202,260	206,687	685,026
TOTAL	170,427	180,379	191,982	291,163	295,590	1,129,541**
Salable Plants per Year	18,156	25,418	27,162	8,177	11,954	90,867
Annual Cost per Salable Plant	9.39	7.10	7.07	35.61	24.73	12.43

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc.
**Individual figures do not always add to the total due to rounding.
***Tree liners were purchased rather than propogated. Liner costs were included under materials.

TABLE 15.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) per Salable Plant of Operating a 50 Acre Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Group I (Taxus)		Group II (Juniper)		Group III (Viburnum)		Group IV (Acer rubrum)		Group V (Malus)		Average	
	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost
Fixed Cost Items												
Land and Improvements	1.70	(10)	1.22	(10)	1.14	(9)	3.78	(7)	2.58	(7)	1.70	(8)
Buildings	1.14	(7)	.82	(7)	.76	(6)	2.54	(5)	1.73	(5)	1.14	(6)
Machinery and Equipment	3.18	(18)	2.27	(18)	2.12	(18)	7.05	(13)	4.82	(13)	3.17	(16)
General Overhead	4.97	(28)	3.54	(28)	3.32	(28)	11.01	(20)	7.54	(20)	4.96	(24)
Interest on General Overhead, Insurance, and Taxes	.32	(2)	.23	(2)	.22	(2)	.71	(1)	.49	(1)	.32	(1)
Subtotal	11.31	(65)	8.08	(65)	7.56	(63)	25.09	(46)	17.16	(46)	11.29	(55)
Variable Cost Items												
Propagation	.66	(4)	.28	(2)	.26	(3)	**		**		.29	(1)
Materials	.98	(5)	.75	(6)	.76	(6)	16.56	(30)	10.05	(27)	3.45	(17)
Machinery and Equipment	1.42	(8)	1.03	(8)	.96	(8)	5.30	(10)	3.39	(9)	1.78	(9)
Labor	2.75	(16)	2.13	(17)	2.21	(18)	5.97	(11)	5.48	(15)	3.07	(15)
Interest on Operating Capital	.35	(2)	.25	(2)	.25	(2)	1.67	(3)	1.14	(3)	.52	(3)
Subtotal	6.16	(35)	4.44	(35)	4.44	(37)	29.50	(58)	20.06	(54)	9.11	(45)
Total Annual costs	17.47	(100)	12.52	(100)	12.00	(100)	54.58	(100)	37.22	(100)	20.40	(100)

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc.
**Tree liners were purchased rather than propagated. Liner costs were included under materials.

TABLE 15a.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) per Salable Plant of Operating a 200 Acre* Field Nursery, U.S.D.A. Plant Hardiness Zones Five and Six, 1985.

Item	Group I (Taxus)		Group II (Juniper)		Group III (Viburnum)		Group IV (Acer rubrum)		Group V (Malus)		Average	
	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost
Fixed Cost Items												
Land and Improvements	1.20	(13)	.85	(12)	.80	(11)	2.66	(7)	1.82	(7)	1.19	(10)
Buildings	.38	(4)	.27	(4)	.25	(4)	.83	(2)	.57	(2)	.37	(3)
Machinery and Equipment	1.40	(15)	1.00	(14)	.94	(13)	3.11	(9)	2.13	(9)	1.40	(11)
General Overhead	1.80	(19)	1.28	(18)	1.20	(17)	4.00	(11)	2.73	(11)	1.80	(14)
Interest on General Overhead, Insurance, and Taxes	.12	(1)	.08	(1)	.08	(1)	.27	(1)	.18	(1)	.12	(1)
Subtotal	4.90	(52)	3.48	(49)	3.27	(46)	10.87	(30)	7.43	(30)	4.88	(39)
Variable Cost Items												
Propagation	.20	(2)	.10	(1)	.10	(1)	**		**		.10	(1)
Materials	.94	(10)	.77	(11)	.77	(11)	13.88	(39)	9.02	(37)	3.07	(25)
Machinery and Equipment	.65	(7)	.47	(7)	.52	(8)	3.03	(9)	2.51	(10)	1.02	(8)
Labor	2.45	(26)	2.05	(29)	2.19	(31)	6.43	(18)	4.79	(19)	2.93	(24)
Interest on Operating Capital	.25	(3)	.20	(3)	.21	(3)	1.40	(4)	.98	(4)	.43	(3)
Subtotal	4.49	(48)	3.59	(51)	3.79	(54)	24.74	(70)	17.30	(70)	7.55	(61)
Total Annual costs	9.39	(100)	7.07	(100)	7.06	(100)	35.61	(100)	24.73	(100)	12.43	(100)

*Total Nursery - 200 acres, 170 acres of growing space, 30 acres production facilities, holding & field bed area, roads, etc.
**Tree liners were purchased rather than propagated. Liner costs were included under materials.

APPENDIX A

Production Cycle for Propagation

Slow Growing Evergreens (Taxus)

November & December of the First Production Year

1. Collecting Cuttings. Collect cuttings from field plants that are at least three years old. Cuttings should measure at least 7 inches. Cuttings are collected at a rate of 1400 per hour.
2. Preparing Cuttings. Strip lower needles off lower 4" of cuttings and dip into IBA power #8. Cuttings are prepared at a rate of 1000 per hour.
3. Sticking Cuttings. Stick treated cuttings into a bottom heated sand bed in overwinter house. Sticking is accomplished at a rate of 1200 per hour.
4. Irrigation. Using an automatic mist system keep watered until rooted then reduce watering.

January - December of the Second Production Year

1. Irrigation. Keep cuttings moist.
2. Fertilization. Liquid feed every two weeks between April and August.

March of the Third Production Year

1. Harvest. Pull rooted cuttings from propagation beds and prune prior to transplanting into field beds.

APP. A- 2

Fast Growing Evergreens (Junipers)

November-December of the First Production Year

1. Collecting Cuttings. Collect cuttings from plants at least three years old. Cuttings should measure at least seven inches. Cuttings are collected at rate of 600 per hour.
2. Preparing Cuttings. Strip lower leaves off lower 3" and dip into IBA power #3. Cuttings can be prepared at a rate of 500 per hour.
3. Sticking Cuttings. Stick treated cuttings into a bottom heated sand bed in overwinter house. Cuttings can be stuck at a rate of 1000 per hour.
4. Irrigation. Using an automatic mist system keep watered until rooted than reduce watering.

March of the Second Production Year

1. Harvest. Pull rooted cuttings from propagation beds for pruning befor transplanting into field beds. Harvesting is accomplished at a rate of 500 cuttings per hour.

APP. A- 3

Deciduous Shrubs (Forsythia & Viburnum)

June of the First Production Year

1. Collect Cuttings. Collect cuttings from field plants at least two years old. Cuttings are collected at a rate of 1000 per hour.
2. Preparing Cuttings. Strip off the lower leaves and dip into IBA power #1. Cuttings are prepared at a rate of 1000 per hour.
3. Sticking Cuttings. Treated cuttings are stuck into a bottom heated sand bed a overwinter house. They are stuck at a rate of 1000 per hour.
4. Irrigation. Using an automatic mist system cuttings are kept watered until rooted. After rooting, reduce irrigation.

July of the First Production Year - March of the Second Production Year

1. Maintenance of Plants. Standard irrigation and feeding.

March of the Second Production Year

1. Harvesting. Pull rooted cuttings from propagation beds prior to transplanting into field beds. Cuttings are harvested at a rate of 400 per hour.

APPENDIX B

Production Cycle for Field Produced

Slow Growing Evergreens (Taxus)

"Seven Year Field Cycle"

LINER PRODUCTION

April of the First Production Year

1. Land Preparation Prior to Planting Bed Liners. The bed area for growing rooted cuttings is prepared by plowing land with a three bottom plow. One ton of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are custom applied by a local fertilizer distributor. The land is further worked, twice with a disk and then harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) into the top two to three inches of soil. The herbicide is sprayed onto the soil using a spray rig and 10 foot boom attached to the tractor pulling the cultimulcher.

May of the First Production Year

1. Liner Preparation. Liners (18 months old) are root pruned by hand prior to planting.
2. Planting of Liners. Pruned liners are transported to the bed area in a flatbed truck. They are then

transplanted into beds, four feet wide, using a three row mechanical transplanter. The rooted cuttings are spaced 20" apart between rows and 7" within rows. Using a crew of 9, approximately 5,000 rooted cuttings can be planted per hour.

1. Irrigation. Irrigation of rooted cuttings is of primary concern the first year during root system development. Portable aluminum four inch pipe is set-up and shifted within the first year's bed area to supplement natural rainfall. Plants are irrigated 20 times during the summer and fall at the rate of one inch of water per irrigation.
2. Fertilization. Nutrients (200 lbs. of soluble 20-20-20 fertilizer/acre/application) are injected three times into the irrigation water to help stimulate plant growth.
3. Weed Control. Weed control is effected by a combination of six mechanical cultivations, three hand weedings and two applications of herbicides. The spring herbicide program consists of spraying the area with 1.0 lb. aia of Simazine 80WP plus 5.25 lbs aia of DCPA 75WP. The fall herbicide program involves spraying the beds with 2.0 lbs. aia of Simazine 80WP.
4. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs.

of Carbaryl 80WP per acre) and fungicides (0.5 lbs. Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.

5. Pruning. Where necessary, bedplants are lightly pruned of any straying branches.

May - September of 2nd and 3rd Production Years

1. Plant Maintenance. The same cultural practices that occurred in the first growing season, May - September, are repeated for the second and third growing seasons.

April of the Fourth Production Year

1. Harvesting of Bed Liners. The three-year bed liners are dug using a fifty inch undercutter with lift tines. The liners are separated from each other and bundled in lots of 25. The bundles are loaded onto pallets which have been placed on a flatbed truck. The truck is then driven into the storage building where the pallets are unloaded using a 4-wheel drive articulated loader.

May - September of the Fourth Production Year

1. Land Preservation. After the bed liners are harvested, the land is left fallow until the next spring planting season. Weeds are kept down through disking the bed area four times during the third growing season.

App. B-4

Ideally, a cover crop (Sudex, for example) would be grown for one or two seasons to restore organic matter and to reduce soil compaction.

PRODUCTION IN THE FIELD

April of the First Field Production Year

1. Land Preparation. Prior to transplanting the bed liners into the field, the land would be plowed. After plowing, three tons of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are custom applied by a local fertilizer distributor. The lime and fertilizer are disked in and the ground is later harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) and to break-up clods of soil whoch could clog a mechanical transplanter.
2. Liner Preparation. The three-year old bed liners are root and top pruned by hand prior to planting to help initiate new roots and compact branching.
3. Planting of Liners. Pruned liners are transported to the field area on a flatbed truck and mechanically transplanted at a rate of 5,065 plants per acre with 44" between rows and 28" between plants. Using a two-row transplanter pulled by a 75HP tractor, an 8 man crew can

plant approximately 2,400 liners per hour.

4. Irrigation. Two irrigations are used to help set the liners.

May - September of the First Field Production Year

1. Weed Control. Two applications of herbicides, two mechanical cultivations, four mowings and two hand weedings are required. Early season (1.0 lb. ai/a Simazine, 5.25 lbs. ai/a DCPA) and late season (2.0 ai/a Simazine) herbicides are applied using a spray rig with a 10 foot boom mounted upon a 34HP tractor. The late season herbicide is applied after the last cultivation. Mechanical cultivation (two-row cultivator attached to a 34HP tractor) is utilized within rows to help eradicate weeds. Hand hoeing is then accomplished to reach weeds not eradicated by cultivators.
2. Fertilizer Program. Supplemental nitrogen, 220 lbs. of Urea (45-0-0) per acre, is side dressed in early fall for increased plant growth.
3. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs. of Carbaryl 80WP per acre) and fungicides (0.5 lbs. of Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.
4. Pruning. Tips of branches are pruned with hedge shears

to induce branching.

May - September of the 2nd through 6th Field Production Year

1. Plant Maintenance. Plant maintainance during these five years is identical to the first season except for an additional application of nitrogen fertilizer, 220 lbs. of Urea (45-0-0) per acre, side dressed each spring.

September of the Sixth Field Production Year

1. Harvesting. Twenty-five percent of the saleable crop is selected and tagged for digging (small nursery - 1,035 plants; large nursery - 4,539 plants). Seven plants per labor hour are "balled and burlapped", carried out of the field, and loaded onto pallets on a flatbed truck parked at the side of the field. The palletized plants are transported to the shipping area, unloaded, and organized according to customer order.
2. Shipping. All plants harvested are loaded onto a semitruck. A crew of 4, with an articulated 4-wheel drive loader, can load 690 plants (truck capacity) in two hours.

October - December of the Sixth Field Production Year

1. Harvesting and Overwintering. An additional 25 percent of the total saleable stock is dug for early spring sales and overwintered in polyhouses (small nursery -

1,035 plants; large nursery - 4,534 plants). Pallets of dug material are unloaded and the material is spaced within the polyhouse framework (2' on centers with a 2' aisle way).

2. Irrigation. The permanent irrigation system is used an estimated 5 times to supply additional moisture to supplement natural rainfall.
3. Covering of Polyhouses. Polyhouses are covered as late as possible with 4-mil white polyfilm which acts as a barrier to drying winds, extremes in temperature, and humidity loss.
4. Fungus Control. Covered polyhouses are fumigated with a fumigant bomb (3-10M cu. ft. Exothermic Termil bombs per polyhouse) to control storage molds and fungi.

January - March of the Seventh Field Production Year

1. Inspection of Fall Dug Materials. Fall dug plants are checked for any possible winter damage.
2. Fungus Control. A second set of fumigant bombs are set-off to further control molds and fungi.
3. Shipping of Fall Dug Material. Shipments of overwintered plants start in late February with stock being loaded onto pallets, hauled to the shipping area, and loaded onto trucks. Approximately 18.5% of the total saleable crop is shipped (small nursery - 766 plants; large nursery - 3,359 plants).

4. Harvesting. Twenty percent of the total saleable crop is harvested (small nursery - 828 plants; large nursery - 3,531 plants).

April of the Seventh Field Production Year

1. Inspection and Shipping of Remaining Fall Dug Material. Any remaining overwintered stock is shipped. Care is exercised to avoid mixing overwintered and spring harvested plants.
2. Harvesting. The remaining 30 percent of the total saleable crop is harvested and hauled into the shipping area (small nursery - 1,242 plants; large nursery 5,446 plants).
3. Irrigation. Plants are irrigated using a portable irrigation system combined with the inground system to help supplement natural rainfall, especially during sunny and windy days.
4. Shipping. Approximately 38 percent of the total saleable crop is shipped (small nursery 1,573 plants; large nursery - 6,899 plants).

May of the Seventh Field Production Year

1. Irrigation. Five irrigations are supplied to remaining saleable plants to maintain quality.
2. Shipping. The remaining 18.5 percent of saleable plants are pulled from the holding area, transported on pallets

to the shipping area, arranged according to customer order, loaded, and shipped (small nursery 766 plants; large nursery 3,359 plants).

3. Shifting of Irrigation Equipment. Portable irrigation pipe is taken down and used in the summer irrigation system of the bed liners.

Summer and Fall of the Seventh Field Production Year

1. Land Preservation. AFter the last plants are harvested, the empty fields are left fallow. Fallow fields are disked for weed control four times during summer months.
2. Land Preparation. Fields are plowed in the fall in preparation for spring planting.

APPENDIX C

Production Cycle for Field Produced

Rapid Growing Evergreens (Juniperus)

"Five Year Field Cycle"

LINER PRODUCTION

April of the First Production Year

1. Land Preparation Prior to Planting Bed Liners. The bed area for growing rooted cuttings is prepared by plowing land with a three bottom plow. One ton of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are custom applied by a local fertilizer distributor. The land is further worked, twice with a disk and then harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) into the top two to three inches of soil. The herbicide is sprayed onto the soil using a spray rig and 10 foot boom attached to the tractor pulling the cultimulcher.

May of the First Production Year

1. Liner Preparation. Liners (6 months old) are root pruned by hand prior to planting.
2. Planting of Liners. Pruned liners are transported to the bed area in a flatbed truck. They are then

transplanted into beds, four feet wide, using a three row mechanical transplanter. The rooted cuttings are spaced 20" apart between rows and 7" within rows. Using a crew of 9, approximately 5,000 rooted cuttings can be planted per hour.

1. Irrigation. Irrigation of rooted cuttings is of primary concern the first year during root system development. Portable aluminum four inch pipe is set-up and shifted within the first year's bed area to supplement natural rainfall. Plants are irrigated 20 times during the summer and fall at the rate of one inch of water per irrigation.
2. Fertilization. Nutrients (200 lbs. of soluble 20-20-20 fertilizer/acre/application) are injected three times into the irrigation water to help stimulate plant growth.
3. Weed Control. Weed control is effected by a combination of six mechanical cultivations, three hand weedings and two applications of herbicides. The spring herbicide program consists of spraying the area with 1.0 lb. aia of Simazine 80WP plus 5.25 lbs aia of DCPA 75WP. The fall herbicide program involves spraying the beds with 2.0 lbs. aia of Simazine 80WP.
4. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs.

of Carbaryl 80WP per acre) and fungicides (0.5 lbs. Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.

5. Pruning. Where necessary, bedplants are lightly pruned of any straying branches.

May - September of the Second Production Year

1. Plant Maintenance. The same cultural practices that occurred in the first growing season, May - September, are repeated for the second growing season.

April of the Second Production Year

1. Harvesting of Bed Liners. The two-year bed liners are dug using a fifty inch undercutter with lift tines. The liners are separated from each other and bundled in lots of 25. The bundles are loaded onto pallets which have been placed on a flatbed truck. The truck is then driven into the storage building where the pallets are unloaded using a 4-wheel drive articulated loader.

May - September of the Second Production Year

1. Land Preservation. After the bed liners are harvested, the land is left fallow until the next spring planting season. Weeds are kept down through disking the bed area four times during the second growing season.

App. C-4

Ideally, a cover crop (Sudex, for example) would be grown for one or two seasons to restore organic matter and to reduce soil compaction.

PRODUCTION IN THE FIELD

April of the First Field Production Year

1. Land Preparation. Land would be plowed the fall prior to transplanting bed liners into the field. Before transplanting, three tons of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are custom applied by a local fertilizer distributor. The lime and fertilizer are disked in and the ground is later harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) and to break-up clods of soil which could clog a mechanical transplanter.
2. Liner Preparation. The two-year old bed liners are root and top pruned by hand prior to planting to help initiate new roots and compact branching.
3. Planting of Liners. Pruned liners are transported to the field area on a flatbed truck and mechanically transplanted at a rate of 5,065 plants per acre with 44" between rows and 28" between plants. Using a two-row transplanter pulled by a 75HP tractor, an 8 man crew can

plant approximately 2,400 liners per hour.

4. Irrigation. Two irrigations are used to help set the liners.

May - September of the First Field Production Year

1. Weed Control. Two applications of herbicides, two mechanical cultivations, four mowings and two hand weedings are required. Early season (1.0 lb. aia Simazine, 5.25 lbs. aia DCPA) and late season (2.0 aia Simazine) herbicides are applied using a spray rig with a 10 foot boom mounted upon a 34HP tractor. The late season herbicide is applied after the last cultivation. Mechanical cultivation (two-row cultivator attached to a 34HP tractor) is utilized within rows to help eradicate weeds. Hand hoeing is then accomplished to reach weeds not eradicated by cultivators.
2. Fertilizer Program. Supplemental nitrogen, 220 lbs. of Urea (45-0-0 per acre), is side dressed in early fall for increased plant growth.
3. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs. of Carbaryl 80WP per acre) and fungicides (0.5 lbs. of Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.
4. Pruning. Tips of branches are pruned with hedge shears

to induce branching.

May - September of the 2nd, 3rd and 4th Field Production Years

1. Plant Maintenance. Plant maintainance during these three years is identical to the first season except for an additional application of nitrogen fertilizer, 220 lbs. of Urea (45-0-0 per acre), side dressed each spring.

September of the Fourth Field Production Year

1. Harvesting. Twenty-five percent of the saleable crop is selected and tagged for digging (small nursery - 1,452 plants; large nursery - 6,355 plants). Seven plants per labor hour are "balled and burlapped", carried out of the field, and loaded onto pallets on a flatbed truck parked at the side of the field. The palletized plants are transported to the shipping area, unloaded, and organized according to customer order.
2. Shipping. All plants harvested are loaded onto a semitruck. A crew of 4, with an articulated 4-wheel drive loader, can load 690 plants (truck capacity) in two hours.

October - December of the Fourth Field Production Year

1. Harvesting and Overwintering. An additional 25 percent of the total saleable stock is dug for early spring

sales and overwintered in polyhouses (small nursery - 1,452 plants; large nursery - 6,355 plants). Pallets of dug material are unloaded and the material is spaced within the polyhouse framework (2' on centers with a 2' aisle way).

2. Irrigation. The permanent irrigation system is used an estimated 5 times to supply additional moisture to supplement natural rainfall.
3. Covering of Polyhouses. Polyhouses are covered as late as possible with 4-mil white polyfilm which acts as a barrier to drying winds, extremes in temperature, and humidity loss.
4. Fungus Control. Covered polyhouses are fumigated with a fumigant bomb (3-10M cu. ft. Exothermic Termil bombs per polyhouse) to control storage molds and fungi.

January - March of the Fifth Field Production Year

1. Inspection of Fall Dug Materials. Fall dug plants are checked for any possible winter damage.
2. Fungus Control. A second set of fumigant bombs are set-off to further control molds and fungi.
3. Shipping of Fall Dug Material. Shipments of overwintered plants start in late February with stock being loaded onto pallets, hauled to the shipping area, and loaded onto trucks. Approximately 18.5% of the total saleable crop is shipped (small nursery - 1,075

plants; large nursery - 4,702 plants).

4. Harvesting. Twenty percent of the total saleable crop is harvested (small nursery - 1,162 plants; large nursery - 5,084 plants).

April of the Fifth Field Production Year

1. Inspection and Shipping of Remaining Fall Dug Material. Any remaining overwintered stock is shipped. Care is exercised to avoid mixing overwintered and spring harvested plants.
2. Harvesting. The remaining 30 percent of the total saleable crop is harvested and hauled into the shipping area (small nursery - 1,743 plants; large nursery - 7,625 plants).
3. Irrigation. Plants are irrigated using a portable irrigation system combined with the inground system to help supplement natural rainfall, especially during sunny and windy days.
4. Shipping. Approximately 38 percent of the total saleable crop is shipped (small nursery - 2,208 plants; large nursery - 9,659 plants).

May of the Fifth Field Production Year

1. Irrigation. Five irrigations are supplied to remaining saleable plants to maintain quality.
2. Shipping. The remaining 18.5 percent of saleable plants

are pulled from the holding area, transported on pallets to the shipping area, arranged according to customer order, loaded, and shipped.

3. Shifting of Irrigation Equipment. Portable irrigation pipe is taken down and used in the summer irrigation system of the bed liners.

Summer and Fall of the Fifth Field Production Year

1. Land Preservation. AFter the last plants are harvested, the empty fields are left fallow. Fallow fields are disked for weed control four times during summer months.
2. Land Preparation. Fields are plowed in the fall in preparation for spring planting.

APPENDIX D

Production Cycle for Field Produced

Deciduous Shrubs (Viburnum)

"Four Year Field Cycle"

LINER PRODUCTION

April of the First Production Year

1. Land Preparation Prior to Planting Bed Liners. The bed area for growing rooted cuttings is prepared by plowing land with a three bottom plow. One ton of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are custom applied by a local fertilizer distributor. The land is further worked, twice with a disk and then harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) into the top two to three inches of soil. The herbicide is sprayed onto the soil using a spray rig and 10 foot boom attached to the tractor pulling the cultimulcher.

May of the First Production Year

1. Liner Preparation. Liners (6 months old) are root pruned by hand prior to planting.
2. Planting of Liners. Pruned liners are transported to the bed area in a flatbed truck. They are then

transplanted into beds, four feet wide, using a three row mechanical transplanter. The rooted cuttings are spaced 20" apart between rows and 7" within rows. Using a crew of 9, approximately 5,000 rooted cuttings can be planted per hour.

1. Irrigation. Irrigation of rooted cuttings is of primary concern the first year during root system development. Portable aluminum four inch pipe is set-up and shifted within the first year's bed area to supplement natural rainfall. Plants are irrigated 20 times during the summer and fall at the rate of one inch of water per irrigation.
2. Fertilization. Nutrients (200 lbs. of soluble 20-20-20 fertilizer/acre/application) are injected three times into the irrigation water to help stimulate plant growth.
3. Weed Control. Weed control is effected by a combination of six mechanical cultivations, three hand weedings and two applications of herbicides. The spring herbicide program consists of spraying the area with 1.0 lb. aia of Simazine 80WP plus 5.25 lbs aia of DCPA 75WP. The fall herbicide program involves spraying the beds with 2.0 lbs. aia of Simazine 80WP.
4. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs.

of Carbaryl 80WP per acre) and fungicides (0.5 lbs. Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.

5. Pruning. Where necessary, bedplants are lightly pruned of any straying branches.

April of the Second Production Year

1. Harvesting of Bed Liners. The two-year bed liners are dug using a fifty inch undercutter with lift tines. The liners are separated from each other and bundled in lots of 25. The bundles are loaded onto pallets which have been placed on a flatbed truck. The truck is then driven into the storage building where the pallets are unloaded using a 4-wheel drive articulated loader.

May - September of the Second Production Year

1. Land Preservation. After the bed liners are harvested, the land is left fallow until the next spring planting season. Weeds are kept down through disking the bed area four times during the second growing season. Ideally, a cover crop (Sudex, for example) would be grown for one or two seasons to restore organic matter and to reduce soil compaction.

PRODUCTION IN THE FIELD

App. D-4

April of the First Field Production Year

1. Land Preparation. Land would be plowed the fall prior to transplanting bed liners into the field. Before transplanting, three tons of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are custom applied by a local fertilizer distributor. The lime and fertilizer are disked in and the ground is later harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) and to break-up clods of soil which could clog a mechanical transplanter.
2. Liner Preparation. The two-year old bed liners are root and top pruned by hand prior to planting to help initiate new roots and compact branching.
3. Planting of Liners. Pruned liners are transported to the field area on a flatbed truck and mechanically transplanted at a rate of 4,356 plants per acre with 48" between rows and 30" between plants. Using a two-row transplanter pulled by a 75HP tractor, an 8 man crew can plant approximately 2,400 liners per hour.
4. Irrigation. Two irrigations are used to help set the liners.

App. D-5

May - September of the First Field Production Year

1. Weed Control. Two applications of herbicides, two mechanical cultivations, four mowings and two hand weedings are required. Early season (1.0 lb. aia Simazine, 5.25 lbs. aia DCPA) and late season (2.0 aia Simazine) herbicides are applied using a spray rig with a 10 foot boom mounted upon a 34HP tractor. The late season herbicide is applied after the last cultivation. Mechanical cultivation (two-row cultivator attached to a 34HP tractor) is utilized within rows to help eradicate weeds growing in spite of herbicides. Hand hoeing is then accomplished to reach weeds not eradicated by cultivators.
2. Fertilizer Program. Supplemental nitrogen, 220 lbs. of Urea (45-0-0 per acre), is side dressed in early fall for increased plant growth.
3. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs. of Carbaryl 80WP per acre) and fungicides (0.5 lbs. of Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.
4. Pruning. Tips of branches are pruned with hedge shears to induce branching.

App. D-6

April - September of the Second Field Production Year

1. Pruning. Plants are pruned to ground level to induce multiple stem plants.
2. Plant Maintenance. Plant maintainance is identical to the first season except for an additional application of nitrogen fertilizer (220 lbs. of Urea, 45-0-0 per acre) side dressed each spring.

April - August of the Third Field Production Year

1. Pruning. Plants are lightly tip-pruned to maintain uniformity and promote secondary branching.
2. Plant Maintenance. Plant maintainance is identical to the second field production year including side dressing nitrogen fertilizer.

September of the Third Field Production Year

1. Harvesting. Twenty-five percent of the saleable crop is selected and tagged for digging (small nursery - 1,552 plants; large nursery - 6,791 plants). Six plants per labor hour are "balled and burlapped", carried out of the field, and loaded onto pallets on a flatbed truck parked at the side of the field. The palletized plants are transported to the shipping area, unloaded, and organized according to customer order.
2. Shipping. All plants harvested are loaded onto a semitruck. A crew of 4, with an articulated 4-wheel drive loader, can load 690 plants (truck capacity) in

two hours.

October - December of the Third Field Production Year

1. Harvesting and Overwintering. An additional 25 percent of the total saleable stock is dug for early spring sales and overwintered in polyhouses (small nursery - 1,552 plants; large nursery - 6,791 plants). Pallets of dug material are unloaded and the material is spaced within the polyhouse framework (2' on centers with a 2' aisle way).
2. Irrigation. The permanent irrigation system is used an estimated 5 times to supply additional moisture to supplement natural rainfall.
3. Covering of Polyhouses. Polyhouses are covered as late as possible with 4-mil white polyfilm which acts as a barrier to drying winds, extremes in temperature, and humidity loss.
4. Fungus Control. Covered polyhouses are fumigated with a fumigant bomb (3-10M cu. ft. Exothermic Termil bombs per polyhouse) to control storage molds and fungi.

January - March of the Fourth Field Production Year

1. Inspection of Fall Dug Materials. Fall dug plants are checked for any possible winter damage.
2. Fungus Control. A second set of fumigant bombs are set-off to further control molds and fungi.

3. Shipping of Fall Dug Material. Shipments of overwintered plants start in late February with stock being loaded onto pallets, hauled to the shipping area, and loaded onto trucks. Approximately 18.5% of the total saleable crop is shipped (small nursery - 1,148 plants; large nursery - 5,025 plants).
4. Harvesting. Twenty percent of the total saleable crop is harvested.

April of the Fourth Field Production Year

1. Inspection and Shipping of Remaining Fall Dug Material. Any remaining overwintered stock is shipped. Care is exercised to avoid mixing overwintered and spring harvested plants.
2. Harvesting. The remaining 30 percent of the total saleable crop is harvested and hauled into the shipping area (small nursery - 1,862 plants; large nursery - 8,149 plants).
3. Irrigation. Plants are irrigated using a portable irrigation system combined with the inground system to help supplement natural rainfall, especially during sunny and windy days.
4. Shipping. Approximately 38 percent of the total saleable crop is shipped (small nursery - 2,359 plants; large nursery - 10,322 plants).

App. D-9

May of the Fourth Field Production Year

1. Irrigation. Five irrigations are supplied to remaining saleable plants to maintain quality.
2. Shipping. The remaining 18.5 percent of saleable plants are pulled from the holding area, transported on pallets to the shipping area, arranged according to customer order, loaded, and shipped (small nursery - 1,148 plants; large nursery - 5,025 plants).
3. Shifting of Irrigation Equipment. Portable irrigation pipe is taken down and used in the summer irrigation system of the bed liners.

Summer and Fall of the Fourth Field Production Year

1. Land Preservation. After the last plants are harvested, the empty fields are left fallow. Fallow fields are disked for weed control four times during summer months.
2. Land Preparation. Fields are plowed in the fall in preparation for spring planting.

APPENDIX E

Production Cycle for Field Grown

Two Inch Shade Trees (Acer rubrum)

"Five Year Field Cycle"

January - March of the First Production Year

1. Linear Preparation. Two year liners are root and top prunned by hand prior to planting to help initiate new roots and compact branching.

April of the First Production Year

1. Land Preparation Prior to Planting. Three tons of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are custom applied by a local fertilizer distributor. The lime and fertilizer are "disked-in" to land that was plowed the previous fall. After disking, the ground is harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) and to break-up clods of soil which could clog a mechanical transplanter.
2. Planting of Liners. Pruned liners are transported to the field area on a flatbed truck and hand transplanted at a rate of 1,361 plants per acre with 96" between rows and 42" between plants. Using a one-row transplanter

pulled by a 75HP tractor, an 18 man crew can prune, haul, plant, and straighten approximately 1,000 liners per hour.

3. Irrigation. Two irrigations would be used to help set the liners.

May - September of the First Production Year

1. Weed Control. Two applications of herbicides, two mechanical cultivations, four mowings and two hand weedings are required. Early season, herbicides (1.0 lb. aia Simazine, 5.25 lbs. aia DCPA) are band applied. Late season, a herbicide (2.0 lbs. aia Simazine) is applied after the last cultivation, using a spray rig with a 7 foot boom mounted on a 34HP tractor. The area between rows is planted with grass (Kentucky 31) leaving a two foot clear band for cultivation and herbicide maintenance. This allows for good soil maintenance, minimum erosion and early access for digging. Mechanical cultivation (one-row cultivator attached to a 34HP tractor) is utilized within the rows to help eradicate weeds growing in spite of herbicides. Hand hoeing is then accomplished to reach weeds not eradicated by cultivators. Grass is mowed four times throughout the year.
2. Fertilizer Program. Supplemental nitrogen, 220 lbs. of Urea (45-0-0 per acre), is side dressed in early fall

for increased plant growth.

3. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs. of Carbaryl 80WP per acre) and fungicides (.5 lbs. Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.
4. Pruning. Tips of branches are pruned with hand shears to induce branching.

May - September of the 2nd, 3rd, and 4th Production Years

1. Plant Maintenance. Maintenance is identical to the first year.

October of the Fourth Production Year

1. Harvesting. Twenty-five percent of the saleable crop is selected and tagged for digging (small nursery - 467 plants; large nursery - 2,044 plants). A digging crew of 7, mechanically digs and transports 16.8 (2.4 per man hour) plants per hour to pallets on a wagon parked at the side of the field. A second crew transports and unloads the palletized plants into the shipping area according to customer orders.
2. Shipping. All plants harvested are loaded onto a semitruck. A crew of 4, with an articulated 4-wheel drive loader, can load 100 plants (truck capacity) in 2

1/2 hours.

November - December of the Fourth Production Year

1. Harvesting and Overwintering. An additional 25 percent of the total saleable stock is dug for early spring sales (small nursery - 467 plants; large nursery - 2,044 plants). Pallets of dug material are unloaded and spaced in rows by variety and size. Overwintering includes "healing-in" the plants in wood chips.
2. Irrigation. The permanent irrigation system, in conjunction with above ground pipe, is used an estimated 5 times to supply moisture to supplement natural rainfall.
3. Rabbit Control. Trunks are sprayed with rabbit repellant.

January - March of the Fifth Production Year

1. Inspection of Fall Dug Materials. Fall dug plants are checked for winter damage (mice, rabbit, sunscald).
2. Rabbit Control. A second application of rabbit repellant is sprayed on tree trunks.
3. Shipping of Fall Dug Material. Shipments of overwintered plants start in late February with stock being loaded onto pallets, hauled to the shipping area, and loaded onto trucks. Approximately 18.5% of the total saleable crop is shipped (small nursery - 346

plants; large nursery - 1,513 plants).

4. Harvesting. Twenty percent of the total saleable crop is harvested (small nursery - 363 plants; large nursery 1,635 plants).

April of the Fifth Production Year

1. Inspection and Shipping of Remaining Fall Dug Material. Any remaining overwintered stock is shipped. Care is exercised to avoid mixing overwintered and spring harvested plants.
2. Harvesting. The remaining 30 percent of the total saleable crop is harvested and hauled into the shipping or holding area prior to "leaf-out" in the field (small nursery - 561 plants; large nursery - 2,453 plants).
3. Irrigation. Plants are irrigated using a portable irrigation system combined with the inground system to help supplement natural rainfall, especially during sunny and windy days.
4. Shipping. Approximately 38 percent of the total saleable crop is shipped (small nursery - 710 plants; large nursery 3,107 plants).

May of the Fifth Production Year

1. Irrigation. Five irrigations are supplied to remaining saleable plants to maintain quality.
2. Shipping. The remaining 18.5 percent of saleable plants

are pulled from the holding area, transported on pallets to the shipping area, loaded and shipped (small nursery - 346 plants; large nursery 1,513 plants).

3. Shifting of Irrigation Equipment. Portable irrigation pipe is taken down and used in the summer irrigation system of the bed liners.

Summer and Fall of the Fifth Production Year

1. Land Preservation. After the last plants are harvested, the empty fields are left fallow. Fallow fields are disked for weed control four times during summer months.
2. Land Preparation. Fields are plowed in the fall in preparation for spring planting.

APPENDIX F

Production Cycle for Field Produced

Ornamental Trees (Malus)

"Four Year Field Cycle"

January - March of the First Production Year

1. Liner Preparation. Two year liners are root and top pruned by hand prior to planting to help initiate new roots and compact branching.

April of the First Production Year

1. Land Preparation Prior to Planting. Three tons of lime and 1130 pounds of blended fertilizer (200 lbs. of 45-0-0, 430 lbs. of 0-44-0, 500 lbs. of 0-0-60) per acre are are custom applied by a local fertilizer distributor. The lime and fertilizer are "disked-in" to land that was plowed the previous fall. After disking, the ground is harrowed. Just prior to planting, fields are cultimulched to help incorporate a pre-emergence herbicide (Trifluralin 4EC at one quart per acre) and to break-up clods of soil which could clog a mechanical transplanter.
2. Planting of Liners. Pruned liners are transported to the field area on a flatbed truck and hand transplanted at a rate of 1,815 plants per acre with 96" between rows and 36" between plants. Using a one-row transplanter

pulled by a 75HP tractor, an 18 man crew can prune, haul, plant, and straighten approximately 1,000 liners per hour.

3. Irrigation. Two irrigations would be used to help set the liners.

May - September of the First Production Year

1. Weed Control. Two applications of herbicides, two mechanical cultivations, four mowings and two hand weedings are required. Early season, herbicides (1.0 lb. aia Simazine, 5.25 lbs. aia DCPA) are band applied. Late season, a herbicide (2.0 aia Simazine) is applied after the last cultivation, using a spray rig with a 7 foot boom mounted on a 34HP tractor. The area between rows is planted with grass (Kentucky 31) leaving a two foot clear band for cultivation and herbicide maintenance. This allows for good soil maintenance, minimum erosion and early access for digging. Mechanical cultivation (one-row cultivator attached to a 34HP tractor) is utilized within the rows to help eradicate weeds. Hand hoeing is then accomplished to reach weeds not eradicated by cultivators. Grass is mowed four times throughout the year.
2. Fertilizer Program. Supplemental nitrogen, 220 lbs. of Urea (45-0-0 per acre), is side dressed in early fall for increased plant growth.

3. Pest Control. Pest control is obtained through the use of insecticides (24 oz. of Malathion 57EL and 1.25 lbs. of Carbaryl 80WP per acre) and fungicides (.5 lbs. Benomyl 50WP per acre). They are sprayed onto the plants three times a growing season utilizing an airblast sprayer pulled by a tractor.
4. Pruning. Tips of branches are pruned with hand shears to induce branching.

February - April of the Second and Third Production Years

1. Pruning. Corrective pruning is carried out to induce better branching.

May - September of the Second and Third Production Years

1. Plant Maintenance. Maintenance is identical to the first year.

October of the Third Production Year

1. Harvesting. Twenty-five percent of the saleable crop is selected and tagged for digging (small nursery - 683 plants; large nursery - 2,989 plants). A digging crew of 7 mechanically digs and transports 16.8 plants per hour (2.4 per man hour) to pallets on a wagon parked at the side of the field. A second crew transports and unloads the palletized plants into the shipping area according to customer orders.

2. Shipping. All plants harvested are loaded onto a semitruck. A crew of 4, with an articulated 4-wheel drive loader, can load 140 (truck capacity) in 2 1/2 hours.

November - December of the Third Production Year

1. Harvesting and Overwintering. An additional 25 percent of the total saleable stock is dug for early spring sales (small nursery - 683 plants; large nursery - 2,989 plants). Pallets of dug material are unloaded and spaced in rows by variety and size. Overwintering includes "heeling-in" the plants in wood chips.
2. Irrigation. The permanent irrigation system, in conjunction with above ground pipe, is used an estimated 5 times to supply moisture to supplement natural rainfall.
3. Rabbit Control. Trunks are sprayed with rabbit repellant.

January - March of the Fourth Production year

1. Inspection of Fall Dug Materials. Fall dug plants are checked for winter damage (mice, rabbit, sunscald).
2. Rabbit Control. A second application of rabbit repellant is sprayed on tree trunks.
3. Shipping of Fall Dug Material. Shipments of overwintered plants start in late February with stock

being loaded onto pallets, hauled to the shipping area, and loaded onto trucks. Approximately 18.5% of the total saleable crop is shipped (small nursery - 505 plants; large nursery 2,211 plants).

4. Harvesting. Twenty percent of the total saleable crop is harvested (small nursery - 546 plants; large nursery - 2,391 plants).

April of the Fourth Production Year

1. Inspection and Shipping of Remaining Fall Dug Material. Any remaining overwintered stock is shipped. Care is exercised to avoid mixing overwintered and spring harvested plants.
2. Harvesting. The remaining 30 percent of the total saleable crop is harvested and hauled into the shipping or holding area prior to "leaf-out" in the field (small nursery - 820 plants; large nursery - 3,586 plants).
3. Irrigation. Plants are irrigated using a portable irrigation system combined with the inground system to help supplement natural rainfall, especially during sunny and windy days.
4. Shipping. Approximately 38 percent of the total saleable crop is shipped (small nursery - 1,038 plants; large nursery - 4,543 plants).

App. F-6

May of the Fourth Production Year

1. Irrigation. Five irrigations are applied to remaining saleable plants to maintain quality.
2. Shipping. The remaining 18.5 percent of saleable plants are pulled from the holding area, transported on pallets to the shipping area, loaded and shipped (small nursery - 505 plants; large nursery - 2,211 plants).
3. Shifting of Irrigation Equipment. Portable irrigation pipe is taken down and used in the summer irrigation system of the bed liners.

Summer and Fall of the Fourth Production Year

1. Land Preservation. After the last plants are harvested, the empty fields are left fallow. Fallow fields are disked for weed control four times during summer months.
2. Land Preparation. Fields are plowed in the fall in preparation for spring planting.